Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts

By:

John R. Slate Ana Rojas-LeBouef

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Online: < http://cnx.org/content/col11292/1.6/ >

CONNEXIONS

Rice University, Houston, Texas

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Chapter 1

Introduction: Why a Book on Statistical Help for Graduate Students and Faculty?¹



NOTE: This Chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups ³

Authors Information

John R. Slate is a Professor at Sam Houston State University where he teaches Basic and Advanced Statistics courses, as well as professional writing, to doctoral students in Educational Leadership and Counseling. His research interests lie in the use of educational databases, both state and national, to reform school practices. To date, he has chaired and/or served over 100 doctoral student dissertation committees. Recently, Dr. Slate created a website, Writing and Statistical Help⁴ to assist students and faculty with both statistical assistance and in editing/writing their dissertations/theses and manuscripts.

¹This content is available online at http://cnx.org/content/m37280/1.2/.

²http://my.goop.com/store/NCPEA-Publications-1781472103076212/

³http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

 $^{^{4}}$ http://cnx.org/content/m37280/latest/www.writingandstatisticalhelp.com

CHAPTER 1. INTRODUCTION: WHY A BOOK ON STATISTICAL HELP FOR GRADUATE STUDENTS AND FACULTY?

Ana Rojas-LeBouef is a Literacy Specialist at the Reading Center at Sam Houston State University where she teaches developmental reading courses. She recently completed her doctoral degree in Reading, where she conducted a 16-year analysis of Texas statewide data regarding the achievement gap. Her research interests lie in examining the inequities in achievement among ethnic groups. Dr. Rojas-LeBouef also assists students and faculty in their writing and statistical needs on the Writing and Statistical website, Writing and Statistical Help⁵

Editors Information

- **Theodore B. Creighton**, is a Professor at Virginia Tech and the Publications Director for NCPEA Publications⁶, the Founding Editor of Education Leadership Review,⁷ and the Senior Editor of the NCPEA Connexions Project.
- **Brad E. Bizzell**, is a recent graduate of the Virginia Tech Doctoral Program in Educational Leadership and Policy Studies, and is a School Improvement Coordinator for the Virginia Tech Training and Technical Assistance Center. In addition, Dr. Bizzell serves as an Assistant Editor of the NCPEA Connexions Project in charge of technical formatting and design.
- Janet Tareilo, is a Professor at Stephen F. Austin State University and serves as the Assistant Director of NCPEA Publications. Dr. Tareilo also serves as an Assistant Editor of the NCPEA Connexions Project and as a editor and reviewer for several national and international journals in educational leadership.
- **Thomas Kersten** is a Professor at Roosevelt University in Chicago. Dr. Kersten is widely published and an experienced editor and is the author of Taking the Mystery Out of Illinois School Finance⁸, a Connexions Print on Demand publication. He is also serving as Editor in Residence for this book by Slate and LeBouef.

1.1 Introduction: Why a Book for Helping Students and Faculty with SPSS and Writing Help?

In the past two decades of teaching basic and advanced statistical procedures, we have observed student after student who experienced difficulty with using the Statistical Package for the Social Sciences (SPSS) and with interpreting the voluminous output generated by SPSS. These difficulties, along with statistics anxiety experienced by many students, led us to develop a specific and detailed set of steps for students to follow. Students reported to us, over and over, how helpful the point-and-click steps were to them in allowing them to use SPSS. Some students, even with the steps, still managed to experience difficulty in being able to use SPSS successfully. As a result, we generated screenshots for every major point-and-click step. This combination of steps and screenshots has met with excellent student satisfaction and, most importantly for us as instructors, has enhanced their ability to be successful in using SPSS.

We have written this textbook in hopes of facilitating individuals' success in using SPSS for their statistical analyses and in interpreting the SPSS output properly. Graduate and undergraduate students who take a statistics course in which SPSS is used will find these steps and screenshots to be very practical and very easy to follow. Doctoral students, who completed their statistics course years ago, but who are now working on their dissertation data analysis will find this textbook to be a practical step-by-guide. Finally, faculty members who engage in scholarly activities but are years removed from their own statistics courses will find this textbook to be helpful.

We hope that you find our materials helpful to you in your use of SPSS and in your interpretation of SPSS output. This textbook reflects our efforts and interests in making statistical analysis less threatening and less anxiety-producing than many persons find it to be. Currently, great emphasis is placed on accountability in

⁵http://cnx.org/content/m37280/latest/www.writingandstatisticalhelp.com

⁶http://www.ncpeapublications.org

 $^{^{7}}$ http://ncpeapublications.org/about-elr.html

 $^{^{8}}$ http://cnx.org/content/col10606/latest/

educational settings. Being able to analyze data, of which an abundance clearly exists, in an interpretable way is essential, especially if we want to make the educational lives of our students better.

John R. Slate, Sam Houston State University Ana Rojas-LeBouef, Sam Houston State University

CHAPTER 1. INTRODUCTION: WHY A BOOK ON STATISTICAL HELP FOR GRADUATE STUDENTS AND FACULTY?

Chapter 2

Calculating Descriptive Statistics¹



NOTE: This Chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

2.1

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- Ana Rojas-LeBouef is a Literacy Specialist at the Reading Center at Sam Houston State University where she teaches developmental reading courses. She recently completed her doctoral degree in Reading, where she conducted a 16-year analysis of Texas statewide data regarding the achievement gap.

 $^{{}^{1}{\}rm This\ content\ is\ available\ online\ at\ <} http://cnx.org/content/m37276/1.9/>.$

²http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

³http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

⁴http://cnx.org/content/m37276/latest/www.writingandstatisticalhelp.com

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2.2 Calculating Descriptive Statistics

In this set of steps, readers are provided with directions on calculating basic measures of central tendency (i.e., mean, median, and mode), measures of dispersion (i.e., standard deviation, variance, and range), and measures of normality (i.e., skewness and kurtosis). For detailed information regarding the advantages and limitations of each of the measures cited, readers are referred to the Hyperstats Online Statistics Textbook at http://davidmlane.com/hyperstat/⁹ or to the *Electronic Statistics Textbook* (2011) at http://www.statsoft.com/textbook/¹⁰

Step One

First check the accuracy of your dataset.

 $\sqrt{\text{Analyze}}$

- * Descriptive Statistics
- * Frequencies

 $^{^{5}} http://cnx.org/content/m37276/latest/www.writingandstatisticalhelp.com$

⁶http://www.ncpeapublications.org

 $^{^{7}}$ http://ncpeapublications.org/about-elr.html

 $^{^{8}} http://cnx.org/content/col10606/latest/$

⁹http://davidmlane.com/hyperstat/

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* Uncheck the display "frequency tables" so that you are not provided with the frequencies of your data every time descriptive statistics are obtained.

Now check your output to see that the values for each of the variables is within the possible limits (e.g., 1 and 2 for gender). If your dataset is inaccurate, correct any inaccuracies before calculating any statistics.

To calculate descriptive statistics:

- $\sqrt{\rm Analyze}$
- * Descriptive Statistics
- * Frequencies
- * Move over the dependent variable/s
- * Do NOT move over the independent variable/s or any string variables
- * Statistics

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* Three basic measures of central tendency, upper right part of screen: mean, median, and mode.

- * Three basic measures of variability, bottom left part of screen: variance, Standard Deviation, and range.
 * Skewness [Note. Skewness refers to the extent to which the data are normally distributed around the mean. Skewed data involve having either mostly high scores with a few low ones or having mostly low scores with a few high ones.] Readers are referred to the following sources for a more detailed definition of skewness: http://www.statistics.com/index.php?page=glossary&term_id=356¹⁴ and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb¹⁵
- * Kurtosis [Note. Kurtosis also refers to the extent to which the data are normally distributed around the mean. This time, the data are piled up higher than normal around the mean or piled up higher than normal at the ends of the distribution.] Readers are referred to the following sources for a more detailed definition of kurtosis: http://www.statistics.com/index.php?page=glossary&term_id=326¹⁶ and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb¹⁷

¹³http://cnx.org/content/m37276/latest/figure1.3.PNG/image

 $^{^{14} \}rm http://www.statistics.com/index.php?page=glossary\&term_id=356$

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* Charts (optional, use only if you want a visual depiction of your data)

* Histograms (optional, use only if you want a visual depiction of your data)with normal curve

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* Uncheck the display frequency tables so that you are not provided with the frequencies of your data every time descriptive statistics are obtained.

* OK

¹⁹http://cnx.org/content/m37276/latest/figure1.5.PNG/image

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To obtain descriptive statistics for subgroups, do the following: * Split File (icon middle top of screen next to the scales)

²⁰http://cnx.org/content/m37276/latest/figure1.6.PNG/image

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18		2	2	578					71	67	79	
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* Compare Groups
* Click on group (typically dichotomous in nature) and move to empty cell.

 $-\frac{1}{21} {\rm http://cnx.org/content/m37276/latest/figure1.7.PNG/image}$

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* OK

 \checkmark Analyze * Descriptive Statistics

* Frequencies

* Move over the dependent variable/s * Do **NOT** move over the independent variable/s or any string variables

²²http://cnx.org/content/m37276/latest/figure1.8.PNG/image

😫 *practice 9	5PSS databa	se revis	sed.sav [Dal	taSet1] - SPS	5 Statistics	Data	Editor					
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 $\sqrt{\text{Statistics}}$

- * Three basic measures of central tendency, upper right part of screen: mean, median, and mode.
- * Three basic measures of variability, bottom left part of screen: variance, Standard Deviation, and range.
 * Skewness [Note. Skewness refers to the extent to which the data are normally distributed around the mean. Skewed data involve having either mostly high scores with a few low ones or having mostly low scores with a few high ones.] Readers are referred to the following sources for a more detailed definition of skewness: http://www.statistics.com/index.php?page=glossary&term_id=356²⁴ and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb²⁵
- * Kurtosis [Note. Kurtosis also refers to the extent to which the data are normally distributed around the mean. This time, the data are piled up higher than normal around the mean or piled up higher than normal at the ends of the distribution.] Readers are referred to the following sources for a more detailed definition of kurtosis: http://www.statistics.com/index.php?page=glossary&term_id=326²⁶ and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb²⁷

* Continue

²³ http://cnx.org/content/m37276/latest/figure1.9.PNG/image

²⁴http://www.statistics.com/index.php?page=glossary&term_id=356

 $^{^{25} \}rm http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsb$

²⁶ http://www.statistics.com/index.php?page=glossary&term_id=326

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* Charts (optional, use only if you want a visual depiction of your data)
* Histograms (optional, use only if you want a visual depiction of your data)with normal curve

 $^{^{28} \}rm http://cnx.org/content/m37276/latest/figure1.10.PNG/image$

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* OK

To calculate a z-score for any continuous variable:

√ Analyze
* Descriptive Statistics
* Descriptives

* Send variable on which you want z-scores to be calculated to empty cell * Check box for Save standardized values as variables

²⁹ http://cnx.org/content/m37276/latest/figure1.11.PNG/image

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* OK

* You will be sent to the output window, as shown in Table 1. [Note. In some versions of SPSS, you will not be sent to the output window, but will remain in the data window.] The information in the output window is not relevant for your purposes. To see the variable that was just created, go to the SPSS data. The far right column should now be the new z-score variable that was created.

Des	$\operatorname{criptive}$	• Statistics			
	Ν	Minimum	Maximum	Mean	Std. Deviation
Verbal IQ (Wechsler Verbal Intelligence 3)	1182	46	129	77.97	13.661
Valid N (listwise)	1182				

* A new variable/s will have been generated for you in the data window

To get this information in a usable output form, do the following:

- $\sqrt{\rm Analyze}$
- * Descriptive Statistics
- * Frequencies
- * Move over the newly created z-score variable(s) (z-scores will generally appear at the bottom of your list with the words: "Zscore: Verbal IQ (Wechsler Verbal Intelligence 3)

³⁰ http://cnx.org/content/m37276/latest/figure1.12.PNG/image

* Make sure the frequencies box is checked

* OK

* Copy or cut the frequency table for this z-score variable and carry it into WORD. Delete any irrelevant information.

		Zscore: Verbal IQ (Wechsler Verbal Intel- ligence 3)	Zscore(wiviq) Verbal IQ (Wechsler Verbal Intelli- gence 3)
Ν	Valid	1182	1182
	Missing	0	0

Table 2.2: Z Scores

To calculate a T-score for any continuous variable:

- \checkmark Analyze * Descriptive Statistics
- * Descriptives
- * Send variable on which you want T scores to be calculated to empty cell
- * Check box for Save standardized values as variables



 $^{31} http://cnx.org/content/m37276/latest/figure1.13.PNG/image$

* OK

* You will be sent to the output window. Nothing in the output window is helpful. Go to the SPSS data screen by clicking on the data button bottom of screen. A new variable(s) will have been generated for you. This variable will be inserted into a formula so that you can have T scores.

* Variable view window

Descriptive Statistics					
	Ν	Minimum	Maximum	Mean	Std. Deviation
Verbal IQ (Wechsler Verbal Intelligence 3)	1182	46	129	77.97	13.661
Valid N (listwise)	1182				

Table 2.3: Descriptive Statistics

 \checkmark Create a new variable for your T score variable

- * Data view window
- * Transform

* Compute Variable

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14			1	624		6	1.00	103	98	108	10
15			1	628		6	1.00	95	99	91	7

* Name your target variable the name you just generated for your T score variable

* In the numeric expression window, type:

* 50 + (10 x [name of the z-score variable generated by the computer earlier])

³²http://cnx.org/content/m37276/latest/figure1.14.PNG/image

20



* OK

³³http://cnx.org/content/m37276/latest/figure1.15.PNG/image

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2		-0.60798	-1.05208	0.00242	-1.05208	0.00242	0.0024
3		-0.31451	-1.05208	0.22201	-1.05208	0.22201	0.2220
4		0.66372	-1.05208	0.95401	-1.05208	0.95401	0.9540
5		-0.60798	-1.05208	0.00242	-1.05208	0.00242	0.0024
6		1.54412	-1.05208	1.61281	-1.05208	1.61281	1.6128
7		-0.60798	-1.05208	0.00242	-1.05208	0.00242	0.0024
8		-0.31451	-1.05208	0.22201	-1.05208	0.22201	0.2220
9		0.66372	-1.05208	0.95401	-1.05208	0.95401	0.9540
10		-0.60798	-1.05208	0.00242	-1.05208	0.00242	0.0024
11		0.37025	-1.05208	0.73441	-1.05208	0.73441	0.7344
12		0.07678	-1.05208	0.51481	-1.05208	0.51481	0.5148
13		0.66372	-1.05208	0.95401	-1.05208	0.95401	0.9540
14		1.34848	-1.05208	1.46641	-1.05208	1.46641	1.4664
15		1.44630	-1.05208	1.53961	-1.05208	1.53961	1.5398
16		1.34848	-1.05208	1.46641	-1.05208	1.46641	1.4664
17		0.85936	-1.05208	1.10041	-1.05208	1.10041	1.1004
18		0.66372	-1.05208	0.95401	-1.05208	0.95401	0.9540
19		1.34848	-1.05208	1.46641	-1.05208	1.46641	1.4664
20		1.44630	-1.05208	1.53961	-1.05208	1.53961	1.5396
21		1.34848	-1.05208	1.46641	-1.05208	1.46641	1.4664
22		0.85936	-1.05208	1.10041	-1.05208	1.10041	1.1004
23		-1.39057	-1.05208	-0.58318	-1.05208	-0.58318	-0.5831
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26		-0.80363	-1.05208	-0.14398	-1.05208	-0.14398	-0.1439
27		1.64194	-1.05208	1.68601	-1.05208	1.68601	1.6860
28		-0.11887	-1.05208	0.36841	-1.05208	0.36841	0.3684
29		-0.80363	-1.05208	-0.14398	-1.05208	-0.14398	-0.1439
30		-0.51016	-1.05208	0.07561	-1.05208	0.07561	0.0758
31		-0.21669	-1.05208	0.29521	-1.05208	0.29521	0.2952
32		0.27242	-1.05208	0.66121	-1.05208	0.66121	0.6612
33	.	-0.41234	-1.05208	0.14881	-1.05208	0.14881	0.1488
34		-0.11887	-1.05208	0.36841	-1.05208	0.36841	0.3684

* Respond yes to change existing variable

* You may be sent to the output screen. Nothing there is helpful.

- * Go to data button and view your new T score variable.
- * To get this information in a usable output form, do the following:

- $\sqrt{\text{Analyze}}$ * Descriptive Statistics
- * Frequencies
- * Move over the newly created T score variable
- * Make sure the frequencies box is checked.

³⁴http://cnx.org/content/m37276/latest/figure1.16.PNG/image

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5		-0.60798	-1.05208	0.00242	-1.05208	0.00242	0.0024:
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8		-0.31451	-1.05208	0.22201	-1.05208	0.22201	0.2220
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25		-2.56444	-1.05208	-1.46158	-1.05208	-1.46158	-1.4615
26		-0.80363	-1.05208	-0.14398	-1.05208	-0.14398	-0.1439
27		1.64194	-1.05208	1.68601	-1.05208	1.68601	1.6860
28		-0.11887	-1.05208	0.36841	-1.05208	0.36841	0.3684
29		-0.80363	-1.05208	-0.14398	-1.05208	-0.14398	-0.1439
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31		-0.21669	-1.05208	0.29521	-1.05208	0.29521	0.2952
32		0.27242	-1.05208	0.66121	-1.05208	0.66121	0.6612 3

* OK

* Copy or cut the frequency table for this T score variable and carry it into WORD. Delete any irrelevant information.

2.3 Writing Up Your Statistics

So, how do you "write up" your Research Questions and your Results? Schuler W. Huck (2000) in his seminal book entitled, *Reading Statistics and Research*, points to the importance of your audience understanding and making sense of your research in written form. Huck further states:

2.3.1

This book is designed to help people *decipher* what researchers are trying to communicate in the written or oral summaries of their investigations. Here, the goal is simply to distill meaning from the words, symbols, tables, and figures included in the research report. To be competent in this arena, one must not only be able to decipher what's presented but also to "fill in the holes"; this is the case because researchers typically

³⁵http://cnx.org/content/m37276/latest/figure1.17.PNG/image

assume that those receiving the research report are familiar with unmentioned details of the research process and statistical treatment of data.

A Note from the Editors

Researchers and Professors John Slate and Ana Rojas-LeBouef understand this critical issue, so often neglected or not addressed by other authors and researchers. They point to the importance of doctoral students "writing up their statistics" in a way that others can understand your reporting and as importantly, interpret the meaning of your significant findings and implications for the preparation and practice of educational leadership. Slate and LeBouef provide you with a model for "writing up your descriptive statistics."

Click here to view: Writing Up Your Descriptive Staistics ³⁶

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 $^{^{36} \}rm http://cnx.org/content/col11299/latest/$

 $^{^{37}}$ http://davidmlane.com/hyperstat/

 $^{^{38} \}rm http://www.statistics.com/index.php?page=glossary\&term~id=326$

³⁹http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb

 $^{^{40}} http://www.statistics.com/index.php?page=glossary\&term_id{=}356$

 $^{^{41}}$ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20 statisticsb

⁴²http://www.statsoft.com/textbook/

Chapter 3

Calculating a Nonparametric Pearson Chi-Square¹



NOTE: This chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

3.1

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups ³

Authors Information

John R. Slate is a Professor at Sam Houston State University where he teaches Basic and Advanced Statistics courses, as well as professional writing, to doctoral students in Educational Leadership and Counseling. His research interests lie in the use of educational databases, both state and national, to reform school practices. To date, he has chaired and/or served over 100 doctoral student dissertation committees. Recently, Dr. Slate created a website (Writing and Statistical Help⁴) to assist students and faculty with both statistical assistance and in editing/writing their dissertations/theses and manuscripts.

¹This content is available online at http://cnx.org/content/m37277/1.5/.

 $^{^{2}}$ http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

³http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

 $^{^{4}} http://cnx.org/content/m37277/latest/www.writingandstatisticalhelp$

Ana Rojas-LeBouef is a Literacy Specialist at the Reading Center at Sam Houston State University where she teaches developmental reading courses. Dr. LeBoeuf recently completed her doctoral degree in Reading, where she conducted a 16-year analysis of Texas statewide data regarding the achievement gap. Her research interests lie in examining the inequities in achievement among ethnic groups. Dr. Rojas-LeBouef also assists students and faculty in their writing and statistical needs on the Writing and Statistical Help website.

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3.2 Conducting a Nonparametric Pearson Chi-Square

In this set of steps, readers are provided with directions on calculating a statistical procedure in which the independent variable and the dependent variable are categorical variables. As such, the only descriptive statistics that can be obtained are frequencies, percentages, and sums. Because the data on which this chi-square procedure is used are grouped data, skewness and kurtosis values are not appropriate. Readers should ensure that the assumptions described in the steps below are met prior to conducting this nonparametric procedure. For more detailed information about the statistical and conceptual underpinnings of this statistical technique, readers are referred to the Hyperstats Online Statistics Textbook at http://davidmlane.com/hyperstat/chi_square.html⁸ or to the *Electronic Statistics Textbook* (2011) at http://www.statsoft.com/textbook/basic-statistics/⁹

3.2.1 Step One:

Check to make sure that both variables are categorical in nature. That is, the variables must have values that are in a restricted range (e.g., 1 or 2 for gender; 1 - 5 for Strongly Agree through Strongly Disagree; 1 - 5 for ethnicity categories).

3.2.2 Step Two:

Check to verify that you have available per cell at least 5 responses (i.e., divide the sample size by the number of cells [number of categories for the IV times the number of categories for the DV] and have a value of at

 $^{^{5}}$ http://www.ncpeapublications.org

 $^{^{6}} http://ncpeapublications.org/about-elr.html$

 $^{^{7}}$ http://cnx.org/content/col10606/latest/

⁸http://davidmlane.com/hyperstat/chi square.html

⁹http://www.statsoft.com/textbook/basic-statistics/

least 5).

3.2.3 Step Three:

Verify that only one response per participant is present. Once these assumptions have been checked and validated, then the Pearson chi-square procedure can be calculated.

3.2.4 Step Four:

- √ Analyze
 * Descriptive Statistics
 * Crosstabs

CHAPTER 3. CALCULATING A NONPARAMETRIC PEARSON CHI-SQUARE

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 $\sqrt{}$ Independent Variable (e.g., gender) in Row

 $\sqrt{}$ Dependent Variable (e.g., responses to a survey item) in Column

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CHAPTER 3. CALCULATING A NONPARAMETRIC PEARSON CHI-SQUARE

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√ OK

3.2.5 Step Five:

Check for Statistical Significance

- 1. Go to the Chi-Square Test Box
- 2. Find Pearson Chi-Square row and Asymp. Sig. (2-sided) column cell

 $^{^{-13} \}rm http://cnx.org/content/m37277/latest/figure2.4.PNG/image$

CHAPTER 3. CALCULATING A NONPARAMETRIC PEARSON CHI-SQUARE

Value dfAsymp.Sig.(2-sided) Pearson Chi-Square 833.549^{a} 118.000 Likelihood Ratio 907.609 118.000 .000 Linear-by-Linear 16.8451 Association N of Valid Cases 1182

Chi-Square Tests

Table 3.1

a. 81 cells (45.0%) have expected count less than 5. The minimum expected count is .23.

3.3 Step Six:

Check Effect Size

- 1. Go to the Symmetric Measures Box
- 2. Find the Nominal by Nominal Cramer's V row and Value column cell
- 3. The effect size is there and must be related to Cohen (1998)

Small effect size = .10 (range of .10 to .299) Medium effect size = .30 (range of .30 to .499) Large effect size = .50 (range of .50 to 1.00)

NOTE: Cramer's V cannot be greater than 1.00

Symmetric Measures

	Value	Approx Sig.
Nominal by Phi	.840	.000
Nominal Cramer's V	.94	.000
N of Valid Cases	1182	

Table 3.2

3.4 Step Seven:

Numerical Sentence

1. $X^2(df)_{sp}={}_{sp}Pearson Chi-Square/Value Cell,{}_{sp}p_{sp}<{}_{sp}.001$ $X^2(1)=833.55, p < .001$

[Note. The sp refers to a space being present where the sp is located.]

3.5 Step Eight:

1. Go to the IV by DV table (i.e., the one above the Chi-Square Tests table)

2. Examine the percentages to determine where the statistically significant differences are

3.6 Step Nine:

Narrative and Interpretation Outline

- 1. Let the reader know what statistical procedure was conducted.
- 2. Explain how the assumptions for this statistical procedure were met.
- 3. Report the results from the test
- 4. Interpret the findings

3.7 Writing Up Your Statistics

So, how do you "write up" your Research Questions and your Results? Schuler W. Huck (2000) in his seminal book entitled, *Reading Statistics and Research*, points to the importance of your audience understanding and making sense of your research in written form. Huck further states:

3.7.1

This book is designed to help people *decipher* what researchers are trying to communicate in the written or oral summaries of their investigations. Here, the goal is simply to distill meaning from the words, symbols, tables, and figures included in the research report. To be competent in this arena, one must not only be able to decipher what's presented but also to "fill in the holes"; this is the case because researchers typically assume that those receiving the research report are familiar with unmentioned details of the research process and statistical treatment of data.

A Note from the Editors

Researchers and Professors John Slate and Ana Rojas-LeBouef understand this critical issue, so often neglected or not addressed by other authors and researchers. They point to the importance of doctoral students "writing up their statistics" in a way that others can understand your reporting and as importantly, interpret the meaning of your significant findings and implications for the preparation and practice of educational leadership. Slate and LeBouef provide you with a model for "writing up your Chi-square statistics."

Click here to view: Writing Up Your Chi-square Staistics ¹⁴

3.8 References

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¹⁴http://cnx.org/content/col11299/latest/

 $^{^{15}}$ http://davidmlane.com/hyperstat/

¹⁶http://www.statistics.com/index.php?page=glossary&term_id=326

 $^{^{17} \}rm http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsb$

 $^{^{18}} http://www.statistics.com/index.php?page=glossary\&term_id{=}356$

 $^{^{19} \}rm http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-st$

 $^{^{20}}$ http://www.statsoft.com/textbook/

CHAPTER 3. CALCULATING A NONPARAMETRIC PEARSON CHI-SQUARE

Chapter 4

Calculating Correlations: Parametric and Non Parametric¹



NOTE: This Chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

4.1

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups ³

Authors Information

John R. Slate is a Professor at Sam Houston State University where he teaches Basic and Advanced Statistics courses, as well as professional writing, to doctoral students in Educational Leadership and Counseling. His research interests lie in the use of educational databases, both state and national, to reform school practices. To date, he has chaired and/or served over 100 doctoral student dissertation committees. Recently, Dr. Slate created a website Writing and Statistical Help⁴ to assist students and faculty with both statistical assistance and in editing/writing their dissertations/theses and manuscripts.

¹This content is available online at http://cnx.org/content/m37278/1.7/.

²http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

³http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

⁴http://www.writingandstatisticalhelp.com

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4.2 Calculating Correlations: Parametric and Nonparametric

In this set of steps, readers will calculate either a parametric or a nonparametric statistical analysis, depending on whether the data reflect a normal distribution. A parametric statistical procedure requires that its data be reflective of a normal curve whereas no such assumption is made in the use of a nonparametric procedure. Of the two types of statistical analyses, the parametric procedure is the more powerful one in ascertaining whether or not a statistically significant relationship, in this case, exists. As such, parametric procedures are preferred over nonparametric procedures. When data are not normally distributed, however, parametric analyses may provide misleading and inaccurate results. Accordingly, nonparametric analyses should be used in cases where data are not reflective of a normal curve. In this set of steps, readers are provided with information on how to make the determination of normally or nonnormally distributed data. For detailed information regarding the assumptions underlying parametric and nonparametric procedures, readers are referred to the Hyperstats Online Statistics Textbook at http://davidmlane.com/hyperstat/⁹ or to the *Electronic Statistics Textbook* (2011) at http://www.statsoft.com/textbook/¹⁰

Research questions for which correlations are appropriate involve asking for relationships between or among variables. The research question, "What is the relationship between study skills and grades for high school students?" could be answered through use of a correlation.

4.2.1 Step One:

Perform ScatterPlots

 $^{^{5}} http://www.writing and statistical help.com$

 $^{^{6} \}rm http://www.ncpeapublications.org$

 $^{^{7}}$ http://ncpeapublications.org/about-elr.html

 $^{^{8}}$ http://cnx.org/content/col10606/latest/

 $^{^{9}}$ http://davidmlane.com/hyperstat/

 $^{^{10} \}rm http://www.statsoft.com/textbook/$

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$\sqrt{\rm Define}$

 $\sqrt{}$ Drag one of the two variables of interest to the first box (Y axis) on the right hand side and the other variable of interest to the second box (X axis) on the right hand side. It does not matter which variable goes in the X or Y axis because your scatterplot results will be the same.

Once you have a variable in each of the two boxes, click on the OK tab on the bottom left hand corner of the screen.

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 $\sqrt{}$ Look at the scatterplots to see whether a linear relationship is present. In the screenshot below, the relationship is very clearly linear.

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CHAPTER 4. CALCULATING CORRELATIONS: PARAMETRIC AND NON PARAMETRIC



4.2.2 Step Two:

Calculate Descriptive Statistics on Variables

- $\sqrt{\text{Analyze}}$
- * Descriptive Statistics
- * Frequencies
- * Click on the variables for which you want descriptive statistics (your dependent variables)
- * You may click on each variable separately or highlight several of them

 $^{^{13} \}rm http://cnx.org/content/m37278/latest/figure3.3.PNG/image$

* * Once you have a variable in the left hand cell highlighted, click on the arrow in the middle to send the variable to the empty cell titled Variable(s)

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 \checkmark Statistics * Click on as many of the options you would like to see results * At the minimum, click on: M, SD, Skewness, and Kurtosis

¹⁴http://cnx.org/content/m37278/latest/figure3.4.PNG/image

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29		602	2	1.00	77	76	81	9	2	6
30		618	2	1.00	83	79	91	8	6	9
31		626	2	1.00	90	82	102	9	10	
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* Continue

- * Charts (these are calculated only if you wish to have visual depictions of skewness and of kurtosis-they are not required)
- * Histograms (not required, optional) with Normal Curve

¹⁵ http://cnx.org/content/m37278/latest/figure3.5.PNG/image

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Histogram

Mean =81.14 Std. Dev. =14.005 N =1,180

17

4.2.3 Step Three:

Check for Skewness and Kurtosis values falling within/without the parameters of normality (-3 to +3)

* Skewness [Note. Skewness refers to the extent to which the data are normally distributed around the mean. Skewed data involve having either mostly high scores with a few low ones or having mostly low scores with a few high ones.] Readers are referred to the following sources for a more detailed definition of skewness: http://www.statistics.com/index.php?page=glossary&term_id=356^{18} and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statistics¹⁹

To standardize the skewness value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the skewness value from the SPSS output (in this case it is -.177) and divide it by the Std. error of skewness (in this case it is .071). If the resulting calculation is within -3 to +3, then the skewness of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.

* Kurtosis [Note. Kurtosis also refers to the extent to which the data are normally distributed around the mean. This time, the data are piled up higher than normal around the mean or piled up higher than normal at the ends of the distribution.] Readers are referred to the following sources for a more detailed definition of kurtosis: http://www.statistics.com/index.php?page=glossary&term_id=326²⁰ and

 $^{^{17}} http://cnx.org/content/m37278/latest/figure 3.7.1. PNG/image$

 $^{^{18} \}rm http://www.statistics.com/index.php?page=glossary\&term_id=356$

 $^{^{19} \}rm http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsb$

 $^{^{20}} http://www.statistics.com/index.php?page=glossary\&term~id{=}326$

 $http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsb^{21}$

To standardize the kurtosis value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the kurtosis value from the SPSS output (in this case it is .072) and divide it by the Std. error of kurtosis (in this case it is .142). If the resulting calculation is within -3 to +3, then the kurtosis of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.

Statistics								
Performance IQ (Wechsler Performance Intelligence 3)								
N	Valid	1180						
	Missing	2						
Mean	81.14							
Std. Deviation		14.005						
Skewness		177						
Std. Error of Skewness		.071						
Kurtosis	.072							
Std. Error of Kurtosis		.142						

Performance IQ (Wechsler Performance Intelligence 3)

Standardized Coefficients Calculator

Copy variable #1 and #2 into the skewness and kurtosis calculator

Table 4.1

 $^{^{21}} http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-stat$

CHAPTER 4. CALCULATING CORRELATIONS: PARAMETRIC AND NON PARAMETRIC

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 $^{22} http://cnx.org/content/m37278/latest/figure 3.8. PNG/image$

4.2.4 Step Four:

Calculate a Correlation Procedure on the Data

 \checkmark Analyze \checkmark Correlate \checkmark Bivariate

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 $^{23} http://cnx.org/content/m37278/latest/figure3.9.PNG/image$

- $\sqrt{$ Send Over Variables on which you want to calculate a correlation by clicking on the variables in the left hand cell and then clicking on the middle arrow to send them to the right hand cell.
- $\sqrt{\text{Perform a Pearson } r}$ if the standardized skewness coefficients and standardized kurtosis coefficients are within normal limits—the Pearson r is the default
- $\sqrt{$ Calculate a Spearman rho if the standardized skewness coefficients and standardized kurtosis coefficients are outside of the normal limits of +/- 3
- $\sqrt{}$ To calculate a Spearman rho, click on the Spearman button and unclick the Pearson r
- $\sqrt{}$ Use the default two-tailed test of significance
- $\sqrt{}$ Use the Flag significant Correlation

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 \sqrt{OK}

4.2.5 Step Five:

Check for Statistical Significance

- 1. Go to the correlation box
- 2. Follow Sig. (2-tailed) row over to chosen variable column
- 3. If you have any value less than .05 or less than your Bonferroni adjustment, if you are calculating multiple correlations on the same sample in the same study, then you have statistical significance.

 $^{^{24} \}rm http://cnx.org/content/m37278/latest/figure 3.10.PNG/image$

CHAPTER 4. CALCULATING CORRELATIONS: PARAMETRIC AND NON PARAMETRIC

Correlations

		Verbal IQ (Wechsler Verbal Intelligence 3)	Performance IQ (Wech- sler Performance Intelli- gence 3)					
Verbal IQ (Wechsler	Pearson Correlation	1	$.664^{**}$					
Verbal Intelligence 3)	Sig. (2-tailed)		.000					
	Ν	1182	1180					
Performance IQ (Wech-	Pearson Correlation	$.664^{**}$	1					
sler Performance Intelli-	Sig. (2-tailed)	.000						
genee 0)	Ν	1180	1180					
**. Correlation is significant at the 0.01 level (2-tailed).								

Table 4.2

NOTE: [In this matrix, it appears that four unique correlations are present, one per cell. In fact, only one unique correlation, or r, is present in this four cell matrix.]

4.2.6 Step Six:

Check For Effect Size

- 1. Go to the correlation box
- 2. Find Pearson's Correlation Row or Spearman rho's and follow it to the variable column.
- 3. Your effect size will be located in the cell where the above intersect.
- 4. The effect size is calculated as:

4.2.6.1 Cohen's criteria for correlations (1998)

- .1 = small (range from .1 to .29)
- .3 = moderate (range from .3 to .49)
- .5 = large (range from .5 to 1.0)

NOTE: Correlations cannot be greater than 1.00, therefore a 0 should not be placed in front of the decimal.

4.2.7 Step Seven:

Check the Level of Variance the Variables Have in Common

- 1. Square the Pearson Correlation Value or Spearman rho value to find the variance
- 2. In this example, the Verbal IQ and the Performance IQ share 44.09% of the variance in common (see correlation value of .664).

Correlations

CHAPTER 4. CALCULATING CORRELATIONS: PARAMETRIC AND NON PARAMETRIC

		Verbal IQ (Wechsler Verbal Intelligence 3)	Performance IQ (Wech- sler Performance Intelli- gence 3)
Verbal IQ (Wechsler	Pearson Correlation	1	.664**
Verbal Intelligence 3)	Sig. (2-tailed)		.000
	Ν	1182	1180
Performance IQ (Wech-	Pearson Correlation	$.664^{**}$	1
sler Performance Intelli-	Sig. (2-tailed)	.000	
genee of	Ν	1180	1180
** Correlation is significated	nt at the 0.01 level (2-taile	ed).	

Table 4.3

4.2.8 Step Eight:

Write the Numerical Sentence

- 1. $r(n)_{sp} = _{sp}$ correlation coefficient, $_{sp}p_{sp} < _{sp}$.001 (or Bonferroni-adjusted alpha significance error rate).
- 2. Using this example: r(1180) = .66, p < .001

NOTE: [sp means to insert a space.] Remember that all mathematical symbols are placed in italics.

4.2.9 Step Nine:

Narrative and Interpretation

- 1. r value
- 2. sample size or n
- 3. p value
- 4. r^2 value
- 5. r(1180) = .66, p < .001, 44.09% of variance accounted for.
- 6. Note that the r value itself is the effect size.

4.3 Writing Up Your Statistics

So, how do you "write up" your Research Questions and your Results? Schuler W. Huck (2000) in his seminal book entitled, *Reading Statistics and Research*, points to the importance of your audience understanding and making sense of your research in written form. Huck further states:

4.3.1

This book is designed to help people *decipher* what researchers are trying to communicate in the written or oral summaries of their investigations. Here, the goal is simply to distill meaning from the words, symbols, tables, and figures included in the research report. To be competent in this arena, one must not only be able to decipher what's presented but also to "fill in the holes"; this is the case because researchers typically assume that those receiving the research report are familiar with unmentioned details of the research process and statistical treatment of data.

Writing Up Your Correlations

Researchers and Professors John Slate and Ana Rojas-LeBouef understand this critical issue, so often neglected or not addressed by other authors and researchers. They point to the importance of doctoral students "writing up their statistics" in a way that others can understand your reporting and as importantly, interpret the meaning of your significant findings and implications for the preparation and practice of educational leadership. Slate and LeBouef provide you with a model for "writing up your Parametric and Non-Parametric Correlations statistics."

Click here to view: Writing Up Your Parametric Correlation Statistics ²⁵

Click here to view: Writing Up Your Nonparamteric Correlation Statistics²⁶

4.4 References

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 $^{^{25}}$ http://cnx.org/content/col11299/latest/

 $^{^{26}}$ http://cnx.org/content/col11299/latest/

 $^{^{27}}$ http://davidmlane.com/hyperstat/

 $^{^{28}} http://www.statistics.com/index.php?page=glossary\&term_id{=}326$

 $^{^{29}} http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-stat$

 $^{^{30}} http://www.statistics.com/index.php?page=glossary\&term_id{=}356$

 $^{^{31} \}rm http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-st$

 $^{^{32}} http://www.statsoft.com/textbook/$

CHAPTER 4. CALCULATING CORRELATIONS: PARAMETRIC AND NON PARAMETRIC

Chapter 5

Conducting a Parametric Independent Samples t-test¹



NOTE: This chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

5.1

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups ³

Authors Information

John R. Slate is a Professor at Sam Houston State University where he teaches Basic and Advanced Statistics courses, as well as professional writing, to doctoral students in Educational Leadership and Counseling. His research interests lie in the use of educational databases, both state and national, to reform school practices. To date, he has chaired and/or served over 100 doctoral student dissertation committees. Recently, Dr. Slate created a website Writing and Statistical Help⁴ to assist students and faculty with both statistical assistance and in editing/writing their dissertations/theses and manuscripts.

¹This content is available online at http://cnx.org/content/m37279/1.5/.

²http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

 $^{^{3}} http://my.qoop.com/store/NCPEA-Publications-1781472103076212/$

⁴http://www.writingandstatisticalhelp.com

Ana Rojas-LeBouef is a Literacy Specialist at the Reading Center at Sam Houston State University where she teaches developmental reading courses. She recently completed her doctoral degree in Reading, where she conducted a 16-year analysis of Texas statewide data regarding the achievement gap. Her research interests lie in examining the inequities in achievement among ethnic groups. Dr. Rojas-LeBouef also assists students and faculty in their writing and statistical needs on the website Writing and Statistical Help.⁵

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- **Thomas Kersten** is a Professor at Roosevelt University in Chicago. Dr. Kersten is widely published and an experienced editor and is the author of Taking the Mystery Out of Illinois School Finance⁸, a Connexions Print on Demand publication. He is also serving as Editor in Residence for this book by Slate and LeBouef.

5.2 Conducting a Parametric Independent Samples t-test

In this set of steps, readers will calculate either a parametric or a nonparametric statistical analysis, depending on whether the data for the dependent variable reflect a normal distribution. A parametric statistical procedure requires that its data be reflective of a normal curve whereas no such assumption is made in the use of a nonparametric procedure. Of the two types of statistical analyses, the parametric procedure is the more powerful one in ascertaining whether or not a statistically significant difference, in this case, exists. As such, parametric procedures are preferred over nonparametric procedures. When data are not normally distributed, however, parametric analyses may provide misleading and inaccurate results. According, nonparametric analyses should be used in cases where data are not reflective of a normal curve. In this set of steps, readers are provided with information on how to make the determination of normally or nonnormally distributed data. For detailed information regarding the assumptions underlying parametric and nonparametric procedures, readers are referred to the Hyperstats Online Statistics Textbook at http://davidmlane.com/hyperstat/⁹ or to the *Electronic Statistics Textbook* (2011) at http://www.statsoft.com/textbook/¹⁰

For this parametric independent samples t-test to be appropriately used, at least half of the standardized skewness coefficients and the standardized kurtosis coefficients must be within the normal range (+/-3, Onwuegbuzie & Daniel, 2002). Research questions for which independent samples t-tests are appropriate involve asking for differences in a dependent variable by group membership (i.e., only two groups are present for t-tests). The research question, "What is the difference between boys and girls in their science performance among middle school students?" could be answered through use of an independent samples t-test.

 $^{^{5}} http://www.writing and statistical help.com$

 $^{^{6} \}rm http://www.ncpeapublications.org$

⁷ http://ncpeapublications.org/about-elr.html

 $^{^{8}}$ http://cnx.org/content/col10606/latest/

 $^{^{9}}$ http://davidmlane.com/hyperstat/

 $^{^{10}} http://www.statsoft.com/textbook/$

5.2.1 Step One

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¹¹http://cnx.org/content/m37279/latest/figure4.1.PNG/image

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- * Standard Deviation
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- To standardize the skewness value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the skewness value from the SPSS output and divide it by the Std. error of skewness. If the resulting calculation is within -3 to +3, then the skewness of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.
- * Kurtosis [Note. Kurtosis also refers to the extent to which the data are normally distributed around the mean. This time, the data are piled up higher than normal around the mean or piled up higher than normal at the ends of the distribution.] Readers are referred to the following sources for a more detailed definition of kurtosis: http://www.statistics.com/index.php?page=glossary&term_id=326¹⁸ and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statistics¹⁹
- To standardize the kurtosis value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the kurtosis value from the SPSS output and divide it by the Std. error of kurtosis. If the resulting calculation is within -3 to +3, then the kurtosis of the dataset

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is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.

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5.3

5.3.1 Step Two

Check for Skewness and Kurtosis values falling within/without the parameters of normality (-3 to +3). Note that each variable below has its own skewness and its own kurtosis values. Thus, a total of three standardized skewness coefficients and three standardized kurtosis coefficients can be calculated from information in the table below.

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Skewness	-1.129	479	-2.197
Std. Error of Skewness	.044	.058	.056
Kurtosis	1.818	412	6.991
Std. Error of Kurtosis	.088	.115	.113

 Table 5.1: Skewness and Kurtosis Coefficients

Standardized Coefficients Calculator

Copy variable #1 and #2 into the skewness and kurtosis calculator

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Note. Prior to calculating parametric independent t-tests, at least half of your standardized coefficients should be within the +/-3 range.

5.4 Step Three

Calculate a Parametric Independent Samples t-test on Data (after you have unsplit your file)

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 $\sqrt{\text{Analyze}}$

 $\sqrt[]{}$ Compare Means

 $\sqrt{}$ Independent Samples *t*-test

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 $\sqrt{\text{Test Variable would be your Dependent Variable (e.g., test scores)}}$

 $\sqrt[4]{}$ Grouping Variable would be your dichotomous Independent Variable

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$\sqrt{}$ Define Groups

 $\sqrt[7]{}$ Group One is No. 1 and Group Two is No. 2 (or whatever numbers you used to identify each group) Note: Click on view than value labels to find the code for each group. $\sqrt{\text{Continue}}$

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5.5 Step Four

Check for Statistical Significance

- * Go to the Independent Samples Test Box (bottom row~ Equal variances not assumed) and look at the cell labeled Sig. (2-tailed) to check for significance. Always use the bottom row.
- * If you have any value less than .05 then you have statistical significance, unless you have adjusted for multiple statistical analyses using the Bonferroni procedure. Remember to replace the third zero with a 1, if the sig value is .000 (i.e., if the sig value reads as .000, replace the third 0, so it reads as .001). If you calculate more than one *t*-test, you must use the

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 Table 5.2:
 Independent Samples Test

- 1. Numerical Sentence = $t(df)_{sp} =_{sp} t_{sp} p_{sp} <_{sp} .001$ (or Bonferroni-adjusted alpha significance error rate).
- df is located in Independent Samples Box
- t is located in Independent Samples Box
- 2. Numerical sentence is written as: t(686.95) = 34.67 p < .001, example was statistically significant.

5.6 Writing Up You Statistcs

So, how do you "write up" your Research Questions and your Results? Schuler W. Huck (2000) in his seminal book entitled, *Reading Statistics and Research*, points to the importance of your audience understanding and making sense of your research in written form. Huck further states:

5.6.1

This book is designed to help people *decipher* what researchers are trying to communicate in the written or oral summaries of their investigations. Here, the goal is simply to distill meaning from the words, symbols,

tables, and figures included in the research report. To be competent in this arena, one must not only be able to decipher what's presented but also to "fill in the holes"; this is the case because researchers typically assume that those receiving the research report are familiar with unmentioned details of the research process and statistical treatment of data.

Researchers and Professors John Slate and Ana Rojas-LeBouef understand this critical issue, so often neglected or not addressed by other authors and researchers. They point to the importance of doctoral students "writing up their statistics" in a way that others can understand your reporting and as importantly, interpret the meaning of your significant findings and implications for the preparation and practice of educational leadership. Slate and LeBouef provide you with a model for "writing up your Independent Samples t -test statistics."

Click here to view: Writing Up Your Independent Samples t-test Statistics ²⁷

5.7 References

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Kurtosis. (n.d.). Definition. Retrieved from http://www.statistics.com/index.php?page=glossary&term_id=326²⁹ Kurtosis. (n.d.). Definition of normality. Retrieved from http://www.statsoft.com/textbook/basic-

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 $^{^{27} \}mathrm{http://cnx.org/content/coll1299/latest/}$

 $^{^{28}}$ http://davidmlane.com/hyperstat/

 $^{^{29} \}rm http://www.statistics.com/index.php?page=glossary\&term~id=326$

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 $^{^{32}}$ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20 statisticsb

³³http://www.statsoft.com/textbook/

CHAPTER 5. CONDUCTING A PARAMETRIC INDEPENDENT SAMPLES T-TEST

Chapter 6

Conducting a Parametric Dependent Samples t-test (Paired Samples t-test)¹



NOTE: This chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

6.1

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups ³

Authors Information

John R. Slate is a Professor at Sam Houston State University where he teaches Basic and Advanced Statistics courses, as well as professional writing, to doctoral students in Educational Leadership and Counseling. His research interests lie in the use of educational databases, both state and national, to reform school practices. To date, he has chaired and/or served over 100 doctoral student dissertation committees. Recently, Dr. Slate created a website Writing and Statistical Help⁴ to assist students and faculty with both statistical assistance and in editing/writing their dissertations/theses and manuscripts.

¹This content is available online at < http://cnx.org/content/m37328/1.6/>.

²http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

 $^{^{3}} http://my.qoop.com/store/NCPEA-Publications-1781472103076212/$

⁴http://www.writingandstatisticalhelp.com

Ana Rojas-LeBouef is a Literacy Specialist at the Reading Center at Sam Houston State University where she teaches developmental reading courses. She recently completed her doctoral degree in Reading, where she conducted a 16-year analysis of Texas statewide data regarding the achievement gap. Her research interests lie in examining the inequities in achievement among ethnic groups. Dr. Rojas-LeBouef also assists students and faculty in their writing and statistical needs on the website Writing and Statistical Help.⁵

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- **Theodore B. Creighton**, is a Professor at Virginia Tech and the Publications Director for NCPEA Publications⁶, the Founding Editor of Education Leadership Review,⁷ and the Senior Editor of the NCPEA Connexions Project.
- **Brad E. Bizzell**, is a recent graduate of the Virginia Tech Doctoral Program in Educational Leadership and Policy Studies, and is a School Improvement Coordinator for the Virginia Tech Training and Technical Assistance Center. In addition, Dr. Bizzell serves as an Assistant Editor of the NCPEA Connexions Project in charge of technical formatting and design.
- Janet Tareilo, is a Professor at Stephen F. Austin State University and serves as the Assistant Director of NCPEA Publications. Dr. Tareilo also serves as an Assistant Editor of the NCPEA Connexions Project and as a editor and reviewer for several national and international journals in educational leadership.
- **Thomas Kersten** is a Professor at Roosevelt University in Chicago. Dr. Kersten is widely published and an experienced editor and is the author of Taking the Mystery Out of Illinois School Finance⁸, a Connexions Print on Demand publication. He is also serving as Editor in Residence for this book by Slate and LeBouef.

6.2 Conducting a Parametric Dependent Samples t-test

In this set of steps, readers will calculate either a parametric or a nonparametric statistical analysis, depending on whether the data for the dependent variable reflect a normal distribution. A parametric statistical procedure requires that its data be reflective of a normal curve whereas no such assumption is made in the use of a nonparametric procedure. Of the two types of statistical analyses, the parametric procedure is the more powerful one in ascertaining whether or not a statistically significant difference, in this case, exists. As such, parametric procedures are preferred over nonparametric procedures. When data are not normally distributed, however, parametric analyses may provide misleading and inaccurate results. According, nonparametric analyses should be used in cases where data are not reflective of a normal curve. In this set of steps, readers are provided with information on how to make the determination of normally or nonnormally distributed data. For detailed information regarding the assumptions underlying parametric and nonparametric procedures, readers are referred to the Hyperstats Online Statistics Textbook at http://davidmlane.com/hyperstat/⁹ or to the *Electronic Statistics Textbook* (2011) at http://www.statsoft.com/textbook/¹⁰

For this parametric dependent samples t-test to be appropriately used, at least half of the standardized skewness coefficients and the standardized kurtosis coefficients must be within the normal range (+/-3, Onwuegbuzie & Daniel, 2002). Research questions for which dependent samples t-tests are appropriate involve asking for differences in a dependent variable by group membership (i.e., only two groups are present for t-tests and, in this case, must be connected). The research question, "What is the effect of a reading intervention program on science performance among elementary school students?" could be answered through use of an dependent samples t-test.

 $^{^{5}}$ http://www.writingandstatisticalhelp.com

⁶http://www.ncpeapublications.org

⁷ http://ncpeapublications.org/about-elr.html

 $^{^{8}}$ http://cnx.org/content/col10606/latest/

⁹http://davidmlane.com/hyperstat/

 $^{^{10}} http://www.statsoft.com/textbook/$

6.3 Step One:

Compute Measures of Normality for the Dependent Variable

 $\sqrt{\text{Analyze}}$ * Descriptive Statistics * Frequencies

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18	190)8041		

 $\sqrt{}$ Move over the dependent (outcome) variable

 $^{-11} http://cnx.org/content/m37328/latest/figure5.1.PNG/image$

CHAPTER 6. CONDUCTING A PARAMETRIC DEPENDENT SAMPLES T-TEST (PAIRED SAMPLES T-TEST)

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- ⁵ Skewness [Note. Skewness refers to the extent to which the data are normally distributed around the mean. Skewed data involve having either mostly high scores with a few low ones or having mostly low scores with a few high ones.] Readers are referred to the following sources for a more detailed definition of skewness: http://www.statistics.com/index.php?page=glossary&term_id=356¹³ and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb¹⁴
- To standardize the skewness value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the skewness value from the SPSS output and divide it by the Std. error of skewness. If the resulting calculation is within -3 to +3, then the skewness of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.
- * Kurtosis [Note. Kurtosis also refers to the extent to which the data are normally distributed around the mean. This time, the data are piled up higher than normal around the mean or piled up higher than normal at the ends of the distribution.] Readers are referred to the following sources for a more detailed definition of kurtosis: http://www.statistics.com/index.php?page=glossary&term_id=326¹⁵ and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb¹⁶
- To standardize the kurtosis value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the kurtosis value from the SPSS output and divide it by the Std. error of kurtosis. If the resulting calculation is within -3 to +3, then the kurtosis of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside

 $^{^{12}} http://cnx.org/content/m37328/latest/figure 5.2.PNG/image$

 $^{^{13}} http://www.statistics.com/index.php?page=glossary&term_id{=}356$

 $^{^{14}} http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-statistic-statisticsbasic-statistic-statistic-statistic-statistic-st$

 $^{{}^{15} \}rm http://www.statistics.com/index.php?page=glossary&term_id=326$

 $^{^{16}} http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-stat$

of this +/-3 range, the dataset is not normally distributed.

- * Continue
- * OK

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* Uncheck the "display frequency tables" so that you are not provided with the frequencies of your data every time descriptive statistics are obtained.

6.4 Step Two:

Check for Skewness and Kurtosis values falling within/without the parameters of normality (-3 to +3). Note that each variable below has its own skewness and its own kurtosis values. Thus, a total of three standardized skewness coefficients and three standardized kurtosis coefficients can be calculated from information in the table below.

	CH005TC09R	CL005TC09R	CW005TC09R
		continued on	next page

¹⁷ http://cnx.org/content/m37328/latest/figure5.3.PNG/image

CHAPTER 6. CONDUCTING A PARAMETRIC DEPENDENT SAMPLES T-TEST (PAIRED SAMPLES T-TEST)

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Kurtosis		1.818	412	6.991
Std. Error of Ku	rtosis	.088	.115	.113

 Table 6.1: Skewness and Kurtosis Coefficients

Standardized Coefficients Calculator

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¹⁸ http://cnx.org/content/m37328/latest/figure5.4.PNG/image

- \checkmark Charts (these are calculated only if you wish to have visual depictions of skewness and of kurtosis-they are not required)
- * Histogram \sim with normal curve (not required, optional)

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6.5 Step Three:

Calculate Paired Samples t-test on Data

- $\sqrt{\text{Analyze}}$
- $\sqrt{}$ Compare Means

 $\sqrt{}$ Paired samples *t*-test

 $^{19} \rm http://cnx.org/content/m37328/latest/figure5.5.PNG/image$

CHAPTER 6. CONDUCTING A PARAMETRIC DEPENDENT SAMPLES T-TEST (PAIRED SAMPLES T-TEST)

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 \checkmark Click on one dependent variable \checkmark Arrow to send over to Paired Variables Side, Variable 1

²⁰http://cnx.org/content/m37328/latest/figure5.6.PNG/image

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 $\sqrt{\rm Click}$ on second dependent variable $\sqrt{\rm Arrow}$ to send over to Paired Variables Side, Variable 2

²¹http://cnx.org/content/m37328/latest/figure5.7.1.PNG/image

CHAPTER 6. CONDUCTING A PARAMETRIC DEPENDENT SAMPLES T-TEST (PAIRED SAMPLES T-TEST)



 \sqrt{OK}

6.6 Step Four:

Check for Statistical Significance

- Go to the Paired Samples Test Box and look at the very last cell labeled Sig. (2-tailed) to check for significance.
- If you have any value less than .05 then you have statistical significance. Remember to replace the third zero with a 1 to a .000 value (i.e., for a value of .000, you would write it as .001).

Paired Samples Test								
Disability Group Member-	Paired I	Differences	3			t	df	Sig.
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Table 6.2: Paired Samples Test

1. Numerical sentence is written as:

Numerical Sentence = $t(df)_{sp} =_{sp} t_{,sp} p_{sp} <_{sp} .001$ (or Bonferroni-adjusted alpha).

- df is located in Paired Samples Box

- t is located in Paired Samples Box

2. The outcome of the paired samples t-test, $t(477) = 164.27 \ p < .001$, was statistically significant.

6.7 Step Five:

Check for Effect Size

 * Use the web-based calculator for effect size using the following websites: Effect Size Calculators for Basic and Multivariate Statistical Procedures²³

Cohen's d (1988)

d of 0.20 = small effect size (range 0.20 to 0.49)

d of 0.50 = moderate effect size (range 0.50 to 0.79)

d of 0.80 =large effect size (range 0.80 and above)

Note. Cohen's d can be greater than 1.00. Therefore, a 0 should be placed in front of the decimal when the value is lower than 1.00.

 $^{23} \rm http://www.uccs.edu/{\sim} faculty/lbecker/$

CHAPTER 6. CONDUCTING A PARAMETRIC DEPENDENT SAMPLES T-TEST (PAIRED SAMPLES T-TEST)



6.8 Step Six:

Narrative and Interpretation

- 1. type of t-test conducted and assumptions met
- 2. t value
- 3. degrees of freedom
- 4. p value

6.9 Writing Up Your Statistics

So, how do you "write up" your Research Questions and your Results? Schuler W. Huck (2000) in his seminal book entitled, *Reading Statistics and Research*, points to the importance of your audience understanding and making sense of your research in written form. Huck further states:

6.9.1

This book is designed to help people *decipher* what researchers are trying to communicate in the written or oral summaries of their investigations. Here, the goal is simply to distill meaning from the words, symbols, tables, and figures included in the research report. To be competent in this arena, one must not only be able to decipher what's presented but also to "fill in the holes"; this is the case because researchers typically assume that those receiving the research report are familiar with unmentioned details of the research process and statistical treatment of data.

Researchers and Professors John Slate and Ana Rojas-LeBouef understand this critical issue, so often neglected or not addressed by other authors and researchers. They point to the importance of doctoral students "writing up their statistics" in a way that others can understand your reporting and as importantly, interpret the meaning of your significant findings and implications for the preparation and practice of educational leadership. Slate and LeBouef provide you with a model for "writing up your parametric dependent sample t-test statistics."

82

Click here to view: Writing Up Your Parametric Dependent Samples t-test Statistics ²⁴

6.10 References

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 $^{^{24}}$ http://cnx.org/content/col11299/latest/

²⁵http://davidmlane.com/hyperstat/

²⁶http://www.statistics.com/index.php?page=glossary&term_id=326

 $^{^{27} \}rm http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statistics/$

²⁸ http://www.statistics.com/index.php?page=glossary&term_id=356

²⁹ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb

 $^{^{30} \}rm http://www.statsoft.com/textbook/$

CHAPTER 6. CONDUCTING A PARAMETRIC DEPENDENT SAMPLES T-TEST (PAIRED SAMPLES T-TEST)

Chapter 7

Conducting a Nonparametric Independent Samples t-test¹



NOTE: This Chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

7.1

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups ³

Authors Information

John R. Slate is a Professor at Sam Houston State University where he teaches Basic and Advanced Statistics courses, as well as professional writing, to doctoral students in Educational Leadership and Counseling. His research interests lie in the use of educational databases, both state and national, to reform school practices. To date, he has chaired and/or served over 100 doctoral student dissertation committees. Recently, Dr. Slate created a website Writing and Statistical Help⁴ to assist students and faculty with both statistical assistance and in editing/writing their dissertations/theses and manuscripts.

¹This content is available online at http://cnx.org/content/m37330/1.6/.

²http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

 $^{^{3}} http://my.qoop.com/store/NCPEA-Publications-1781472103076212/$

⁴http://www.writingandstatisticalhelp.com

Ana Rojas-LeBouef is a Literacy Specialist at the Reading Center at Sam Houston State University where she teaches developmental reading courses. She recently completed her doctoral degree in Reading, where she conducted a 16-year analysis of Texas statewide data regarding the achievement gap. Her research interests lie in examining the inequities in achievement among ethnic groups. Dr. Rojas-LeBouef also assists students and faculty in their writing and statistical needs on the website Writing and Statistical Help.⁵

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- **Thomas Kersten** is a Professor at Roosevelt University in Chicago. Dr. Kersten is widely published and an experienced editor and is the author of Taking the Mystery Out of Illinois School Finance⁸, a Connexions Print on Demand publication. He is also serving as Editor in Residence for this book by Slate and LeBouef.

7.2 Conducting a Nonparametric Independent Samples t-test

In this set of steps, readers will calculate either a parametric or a nonparametric statistical analysis, depending on whether the data for the dependent variable reflect a normal distribution. A parametric statistical procedure requires that its data be reflective of a normal curve whereas no such assumption is made in the use of a nonparametric procedure. Of the two types of statistical analyses, the parametric procedure is the more powerful one in ascertaining whether or not a statistically significant difference, in this case, exists. As such, parametric procedures are preferred over nonparametric procedures. When data are not normally distributed, however, parametric analyses may provide misleading and inaccurate results. According, nonparametric analyses should be used in cases where data are not reflective of a normal curve. In this set of steps, readers are provided with information on how to make the determination of normally or nonnormally distributed data. For detailed information regarding the assumptions underlying parametric and nonparametric procedures, readers are referred to the Hyperstats Online Statistics Textbook at http://davidmlane.com/hyperstat/ or to the Electronic Statistics Textbook (2011) at http://www.statsoft.com/textbook/

For this nonparametric independent samples t-test to be appropriately used, at least half of the standardized skewness coefficients and the standardized kurtosis coefficients must be outside the normal range (+/-3, Onwuegbuzie & Daniel, 2002). Research questions for which nonparametric independent samples t-tests are appropriate involve asking for differences in a dependent variable by group membership (i.e., only two groups are present for t-tests). The research question, "What is the difference between boys and girls in their science performance among middle school students?" could be answered through use of a nonparametric independent samples t-test.

 $^{^{5} \}rm http://www.writing and statistical help.com$

 $^{^{6} \}rm http://www.ncpeapublications.org$

⁷http://ncpeapublications.org/about-elr.html

⁸http://cnx.org/content/col10606/latest/

7.3 Step One:

Calculate Frequencies on the Split Groups

 $\begin{array}{l} \sqrt{\rm Data} \\ * {\rm Split} {\rm \ File} \end{array}$

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Your screen will show that all cases are going to be analyzed and a "do not create groups". You will need to click the compare groups and move the independent variable over to the "Group Based on".

⁹http://cnx.org/content/m37330/latest/figure6.1.PNG/image

CHAPTER 7. CONDUCTING A NONPARAMETRIC INDEPENDENT SAMPLES T-TEST

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⁻¹¹ http://cnx.org/content/m37330/latest/figure6.3.PNG/image

CHAPTER 7. CONDUCTING A NONPARAMETRIC INDEPENDENT SAMPLES T-TEST

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 $\sqrt{}$ Move over the dependent (outcome) variable

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 $\sqrt{\text{Statistics}}$

- * Mean
- * Standard Deviation
- * Skewness [Note. Skewness refers to the extent to which the data are normally distributed around the mean. Skewed data involve having either mostly high scores with a few low ones or having mostly low scores with a few high ones.] Readers are referred to the following sources for a more detailed definition of skewness:
- http://www.statistics.com/index.php?page=glossary&term id=356¹⁴
- $http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statistics b^{15}$
- To standardize the skewness value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the skewness value from the SPSS output and divide it by the Std. error of skewness. If the resulting calculation is within -3 to +3, then the skewness of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.
- * Kurtosis [Note. Kurtosis also refers to the extent to which the data are normally distributed around the mean. This time, the data are piled up higher than normal around the mean or piled up higher than normal at the ends of the distribution.] Readers are referred to the following sources for a more detailed definition of kurtosis:
- To standardize the kurtosis value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the kurtosis value from the SPSS output and divide it by the Std. error of kurtosis. If the resulting calculation is within -3 to +3, then the kurtosis of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside

¹³http://cnx.org/content/m37330/latest/figure6.5.PNG/image

¹⁴http://www.statistics.com/index.php?page=glossary&term_id=356

 $^{^{15} \}rm http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-st$

CHAPTER 7. CONDUCTING A NONPARAMETRIC INDEPENDENT SAMPLES T-TEST

of this +/-3 range, the dataset is not normally distributed.

http://www.statistics.com/index.php?page=glossary&term id= 326^{16}

 $http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statistics b^{17}$

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 $\sqrt{}$ Charts (these are calculated only if you wish to have visual depictions of skewness and of kurtosis-they are not required)

* Histogram~ with normal curve (not required, optional)

 $\sqrt{\text{Continue}}$

√ OK

 $^{^{16}} http://www.statistics.com/index.php?page=glossary\&term_id{=}326$

¹⁷ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb ¹⁸ http://cnx.org/content/m37330/latest/figure6.6.PNG/image

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Note: Before you continue to another application you must complete the following:

 $\sqrt{\rm Data}$

 $\sqrt[V]{}$ Split Files $\sqrt{}$ Analyze all cases, do not create groups $\sqrt{}$ OK

¹⁹http://cnx.org/content/m37330/latest/figure6.7.PNG/image

CHAPTER 7. CONDUCTING A NONPARAMETRIC INDEPENDENT SAMPLES T-TEST

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7.4 Step Two:

Check for Skewness and Kurtosis values falling within/without the parameters of normality (-3 to +3). Note that each variable has its own skewness value and its own kurtosis value. Thus, a total of three standardized skewness coefficients and three standardized kurtosis coefficients can be calculated from information in the table below.

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Skewness	-1.129	479	-2.197
Std. Error of Skewness	.044	.058	.056
Kurtosis	1.818	412	6.991
Std. Error of Kurtosis	.088	.115	.113

 Table 7.1: Skewness and Kurtosis Coefficients

Standard Coefficients Calculator

Copy variable #1 and #2 into the skewness and kurtosis calculator

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7.5 Step Three

Calculate Nonparametric Independent Samples t-test on Data

 $^{^{21} \}rm http://cnx.org/content/m37330/latest/figure6.9.PNG/image$

 $\sqrt{\rm Analyze}$

- $\sqrt{Nonparametric Tests}$
- $\sqrt{2}$ Independent Samples
- $\sqrt{}$ Test Variable would be your Dependent Variable (e.g., test scores)

 $\sqrt{\text{Grouping Variable would be your dichotomous Independent Variable}}$

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 $\sqrt{\text{Define Groups}}$

 $\sqrt{\text{Group One is No. 1 and Group Two is No. 2 (or whatever numbers you used to identify each group)}$ Note: Click on view than value labels to find the code for each group.

 $\sqrt{\text{Continue}}$

√ OK

 $^{22} http://cnx.org/content/m37330/latest/figure6.10.1.PNG/image$

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7.6 Step Four:

Check for Statistical Significance

Test Statistics^a

	Performance IQ(Wechsler Performance Intelligence 3)					
Mann-Whitney U	6765.500					
Wilcoxon W	44166.500					
Z	-20.752					
Asymp. Sig. (2-tailed)	.000					

Table 7.2

a. Grouping Variable:Disability Group Membership

Numerical sentence is written as: U = 6765.50, p < .001

 $^{^{23}} http://cnx.org/content/m37330/latest/figure6.11.1.PNG/image$

CHAPTER 7. CONDUCTING A NONPARAMETRIC INDEPENDENT SAMPLES T-TEST

7.7 Step Five:

Check for Effect Size

 * Use the web-based calculator for effect size using the following websites: Effect Size Calculators for Basic and Multivariate Statistical Procedures^{24}



7.8 Write Up Your Statistics

So, how do you "write up" your Research Questions and your Results? Schuler W. Huck (2000) in his seminal book entitled, *Reading Statistics and Research*, points to the importance of your audience understanding and making sense of your research in written form. Huck further states:

7.8.1

This book is designed to help people *decipher* what researchers are trying to communicate in the written or oral summaries of their investigations. Here, the goal is simply to distill meaning from the words, symbols, tables, and figures included in the research report. To be competent in this arena, one must not only be able to decipher what's presented but also to "fill in the holes"; this is the case because researchers typically assume that those receiving the research report are familiar with unmentioned details of the research process and statistical treatment of data.

Researchers and Professors John Slate and Ana Rojas-LeBouef understand this critical issue, so often neglected or not addressed by other authors and researchers. They point to the importance of doctoral students "writing up their statistics" in a way that others can understand your reporting and as importantly, interpret the meaning of your significant findings and implications for the preparation and practice of educational leadership. Slate and LeBouef provide you with a model for "writing up your nonparametric independent samples *t*-test statistics."

Click here to view: Writing Up Your Nonparametric Independent Samples t-test Statistics ²⁶

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²⁴http://www.uccs.edu/~faculty/lbecker/

 $^{^{25} \}rm http://cnx.org/content/m37330/latest/figure6.12.png/image$

 $^{^{26} \}rm http://cnx.org/content/col11299/latest/$

7.9 References

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- Hyperstats Online Statistics Textbook. (n.d.) Retrieved from http://davidmlane.com/hyperstat/²⁷
- Kurtosis. (n.d.). Definition. Retrieved from http://www.statistics.com/index.php?page=glossary&term_id=326²⁸
- $\label{eq:kurtosis} \begin{array}{ll} {\rm (n.d.).} & Definition \ of \ normality. \ {\rm Retrieved \ from \ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20 statistics^{29} \end{array}$
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 $^{^{27}} http://davidmlane.com/hyperstat/$

²⁸ http://www.statistics.com/index.php?page=glossary&term id=326

 $^{^{29}} http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-statistics/$

³⁰http://www.statistics.com/index.php?page=glossary&term_id=356

 $^{^{31}}$ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20 statisticsb

³²http://www.statsoft.com/textbook/

CHAPTER 7. CONDUCTING A NONPARAMETRIC INDEPENDENT SAMPLES T-TEST

Chapter 8

Conducting a Nonparametric Paired Samples t-test¹



NOTE: This chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

8.1

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups ³

Authors Information

John R. Slate is a Professor at Sam Houston State University where he teaches Basic and Advanced Statistics courses, as well as professional writing, to doctoral students in Educational Leadership and Counseling. His research interests lie in the use of educational databases, both state and national, to reform school practices. To date, he has chaired and/or served over 100 doctoral student dissertation committees. Recently, Dr. Slate created a website Writing and Statistical Help⁴ to assist students and faculty with both statistical assistance and in editing/writing their dissertations/theses and manuscripts.

¹This content is available online at http://cnx.org/content/m37333/1.5/.

²http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

³http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

⁴http://www.writingandstatisticalhelp.com

Ana Rojas-LeBouef is a Literacy Specialist at the Reading Center at Sam Houston State University where she teaches developmental reading courses. She recently completed her doctoral degree in Reading, where she conducted a 16-year analysis of Texas statewide data regarding the achievement gap. Her research interests lie in examining the inequities in achievement among ethnic groups. Dr. Rojas-LeBouef also assists students and faculty in their writing and statistical needs on the website Writing and Statistical Help.⁵

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8.2 Conducting a Nonparametric Paired Samples t-test

In this set of steps, readers will calculate either a parametric or a nonparametric statistical analysis, depending on whether the data for the dependent variable reflect a normal distribution. A parametric statistical procedure requires that its data be reflective of a normal curve whereas no such assumption is made in the use of a nonparametric procedure. Of the two types of statistical analyses, the parametric procedure is the more powerful one in ascertaining whether or not a statistically significant difference, in this case, exists. As such, parametric procedures are preferred over nonparametric procedures. When data are not normally distributed, however, parametric analyses may provide misleading and inaccurate results. According, nonparametric analyses should be used in cases where data are not reflective of a normal curve. In this set of steps, readers are provided with information on how to make the determination of normally or nonnormally distributed data. For detailed information regarding the assumptions underlying parametric and nonparametric procedures, readers are referred to the Hyperstats Online Statistics Textbook at http://davidmlane.com/hyperstat/ or to the Electronic Statistics Textbook (2011) at http://www.statsoft.com/textbook/

For this nonparametric dependent samples t-test to be appropriately used, at least half of the standardized skewness coefficients and the standardized kurtosis coefficients must be outside the normal range (+/-3, Onwuegbuzie & Daniel, 2002). Research questions for which nonparametric dependent samples t-test are appropriate involve asking for differences in a dependent variable by group membership (i.e., only two groups are present for the t-test and, in this case, their scores are connected). The research question, "What is the effect of the new science program on student science performance among elementary school students?" could be answered through use of a nonparametric dependent dependent t-test.

 $^{^{5}}$ http://www.writingandstatisticalhelp.com

 $^{^{6} \}rm http://www.ncpeapublications.org$

 $^{^{7} \}rm http://ncpeapublications.org/about-elr.html$

⁸http://cnx.org/content/col10606/latest/
8.2.1 Step One:

Compute Measures of Normality for the Dependent Variable

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* Descriptive Statistics
* Frequencies

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 $\sqrt{\text{Move over the dependent (outcome) variable}}$

 $^{9} http://cnx.org/content/m37333/latest/figure7.1.PNG/image$

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 $\sqrt{\text{Statistics}}$

- * Skewness [Note. Skewness refers to the extent to which the data are normally distributed around the mean. Skewed data involve having either mostly high scores with a few low ones or having mostly low scores with a few high ones.] Readers are referred to the following sources for a more detailed definition of skewness: http://www.statistics.com/index.php?page=glossary&term_id=356 and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb
- To standardize the skewness value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the skewness value from the SPSS output and divide it by the Std. error of skewness. If the resulting calculation is within -3 to +3, then the skewness of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.
- * Kurtosis [Note. Kurtosis also refers to the extent to which the data are normally distributed around the mean. This time, the data are piled up higher than normal around the mean or piled up higher than normal at the ends of the distribution.] Readers are referred to the following sources for a more detailed definition of kurtosis: http://www.statistics.com/index.php?page=glossary&term_id=326 and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb
- To standardize the kurtosis value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the kurtosis value from the SPSS output and divide it by the Std. error of kurtosis. If the resulting calculation is within -3 to +3, then the kurtosis of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.

^{*} Continue

^{*} OK

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8.2.2 Step Two:

Check for Skewness and Kurtosis values falling within/without the parameters of normality (-3 to +3). Note that each variable below has its own skewness value and its own kurtosis value. Thus, a total of three standardized skewness coefficients and three standardized kurtosis coefficients can be calculated from information in the table below.

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Std. Erro	or of Skewness	.044	.058	.056
Kurtosis		1.818	412	6.991
Std. Err	or of Kurtosis	.088	.115	.113

Table 8.1: Skewness and	Kurtosis	coefficients
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¹¹http://cnx.org/content/m37333/latest/figure7.3.PNG/image

Standard Coefficients Calculator

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* Histogram \sim with normal curve (not required, optional)

¹²http://cnx.org/content/m37333/latest/figure7.4.PNG/image

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8.2.3 Step Three:

Calculate Nonparametric Paired Samples t -test on Data

¹³http://cnx.org/content/m37333/latest/figure7.5.PNG/image

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* OK

¹⁴http://cnx.org/content/m37333/latest/figure7.6.PNG/image

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8.2.4 Step Four:

Check for Statistical Significance

Test Statistics^b

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Table 8.2

a. Based on positive ranks.

b. Wilcoxon Signed Rank test

Numerical sentence is written as: z = -34.83, p < .001

 $^{^{15} \}rm http://cnx.org/content/m37333/latest/figure7.7.PNG/image$

8.2.5 Step Five

Check for Effect Size

* Use the web-based calculator for effect size using the following website: Effect Size Calculators for Basic and Multivariate Statistical Procedures¹⁶



8.3 Writing Up Your Statistics

So, how do you "write up" your Research Questions and your Results? Schuler W. Huck (2000) in his seminal book entitled, *Reading Statistics and Research*, points to the importance of your audience understanding and making sense of your research in written form. Huck further states:

8.3.1

This book is designed to help people *decipher* what researchers are trying to communicate in the written or oral summaries of their investigations. Here, the goal is simply to distill meaning from the words, symbols, tables, and figures included in the research report. To be competent in this arena, one must not only be able to decipher what's presented but also to "fill in the holes"; this is the case because researchers typically assume that those receiving the research report are familiar with unmentioned details of the research process and statistical treatment of data.

Researchers and Professors John Slate and Ana Rojas-LeBouef understand this critical issue, so often neglected or not addressed by other authors and researchers. They point to the importance of doctoral students "writing up their statistics" in a way that others can understand your reporting and as importantly, interpret the meaning of your significant findings and implications for the preparation and practice of educational leadership. Slate and LeBouef provide you with a model for "writing up your nonparametric paired samples t-test."

Click here to view: Writing Up Your Nonparametric Paired Samples t-test Statistics ¹⁸

110

 $^{^{16}} http://www.uccs.edu/\sim faculty/lbecker/$

 $^{^{17}} http://cnx.org/content/m37333/latest/figure 7.8.png/image$

 $^{^{18} \}rm http://cnx.org/content/col11299/latest/$

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- Kurtosis. (n.d.). Definition. Retrieved from http://www.statistics.com/index.php?page=glossary&term_id=326²⁰
- $\label{eq:kurtosis} \begin{array}{ll} \mbox{(n.d.)}. & Definition \ of \ normality. & Retrieved \ from \ http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statistics^{21} \end{array}$
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 $^{^{19}}$ http://davidmlane.com/hyperstat/

 $^{^{20}} http://www.statistics.com/index.php?page=glossary\&term~id=326$

 $^{^{21}} http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-statistics/\#Descriptive\%20 statisticsbasic-statistic$

²²http://www.statistics.com/index.php?page=glossary&term_id=356

²³http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb

²⁴http://www.statsoft.com/textbook/

CHAPTER 8. CONDUCTING A NONPARAMETRIC PAIRED SAMPLES T-TEST

Chapter 9

Conducting a Parametric One-Way Analysis of Variance¹



NOTE: This chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

9.1

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups ³

Authors Information

John R. Slate is a Professor at Sam Houston State University where he teaches Basic and Advanced Statistics courses, as well as professional writing, to doctoral students in Educational Leadership and Counseling. His research interests lie in the use of educational databases, both state and national, to reform school practices. To date, he has chaired and/or served over 100 doctoral student dissertation committees. Recently, Dr. Slate created a website Writing and Statistical Help⁴ to assist students and faculty with both statistical assistance and in editing/writing their dissertations/theses and manuscripts.

¹This content is available online at http://cnx.org/content/m37334/1.4/.

²http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

³http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

⁴http://www.writingandstatisticalhelp.com

Ana Rojas-LeBouef is a Literacy Specialist at the Reading Center at Sam Houston State University where she teaches developmental reading courses. She recently completed her doctoral degree in Reading, where she conducted a 16-year analysis of Texas statewide data regarding the achievement gap. Her research interests lie in examining the inequities in achievement among ethnic groups. Dr. Rojas-LeBouef also assists students and faculty in their writing and statistical needs on the website Writing and Statistical Help.⁵

Editors Information

- **Theodore B. Creighton**, is a Professor at Virginia Tech and the Publications Director for NCPEA Publications⁶, the Founding Editor of Education Leadership Review,⁷ and the Senior Editor of the NCPEA Connexions Project.
- **Brad E. Bizzell**, is a recent graduate of the Virginia Tech Doctoral Program in Educational Leadership and Policy Studies, and is a School Improvement Coordinator for the Virginia Tech Training and Technical Assistance Center. In addition, Dr. Bizzell serves as an Assistant Editor of the NCPEA Connexions Project in charge of technical formatting and design.
- Janet Tareilo, is a Professor at Stephen F. Austin State University and serves as the Assistant Director of NCPEA Publications. Dr. Tareilo also serves as an Assistant Editor of the NCPEA Connexions Project and as a editor and reviewer for several national and international journals in educational leadership.
- **Thomas Kersten** is a Professor at Roosevelt University in Chicago. Dr. Kersten is widely published and an experienced editor and is the author of Taking the Mystery Out of Illinois School Finance⁸, a Connexions Print on Demand publication. He is also serving as Editor in Residence for this book by Slate and LeBouef.

9.2 Conducting a Parametric One-Way Analysis of Variance

In this set of steps, readers will calculate either a parametric or a nonparametric statistical analysis, depending on whether the data for the dependent variable reflect a normal distribution. A parametric statistical procedure requires that its data be reflective of a normal curve whereas no such assumption is made in the use of a nonparametric procedure. Of the two types of statistical analyses, the parametric procedure is the more powerful one in ascertaining whether or not a statistically significant difference, in this case, exists. As such, parametric procedures are preferred over nonparametric procedures. When data are not normally distributed, however, parametric analyses may provide misleading and inaccurate results. According, nonparametric analyses should be used in cases where data are not reflective of a normal curve. In this set of steps, readers are provided with information on how to make the determination of normally or nonnormally distributed data. For detailed information regarding the assumptions underlying parametric and nonparametric procedures, readers are referred to the Hyperstats Online Statistics Textbook at http://davidmlane.com/hyperstat/ or to the Electronic Statistics Textbook (2011) at http://www.statsoft.com/textbook/

For this parametric analysis of variance procedure to be appropriately used, at least half of the standardized skewness coefficients and the standardized kurtosis coefficients must be within the normal range (+/-3,Onwuegbuzie & Daniel, 2002). Research questions for which parametric analysis of variance procedures are appropriate involve asking for differences in a dependent variable by group membership (i.e., more than two groups may be present). The research question, "What is the difference in science achievement among elementary school students as a function of ethnic membership?" could be answered through use of an analysis of variance procedure.

 $^{^{5} \}rm http://www.writing and statistical help.com$

 $^{^{6}} http://www.ncpeapublications.org$

 $^{^{7}}$ http://ncpeapublications.org/about-elr.html

⁸http://cnx.org/content/col10606/latest/

9.2.1 Step One:

Check for Skewness and Kurtosis values falling within/without the parameters of normality (-3 to +3) $\sqrt{\text{Split your file on the basis on your independent variable/fixed factor/grouping variable}}$

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Your screen will show that all cases are going to be analyzed and a "do not create groups". You will need to click the compare groups and move the independent variable over to the "Group Based on". For most ANOVA procedures, your independent or grouping variable will have more than two groups.

¹⁰http://cnx.org/content/m37334/latest/figure8.2.1.PNG/image

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CHAPTER 9. CONDUCTING A PARAMETRIC ONE-WAY ANALYSIS OF VARIANCE

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 \checkmark Move over the dependent (outcome) variable

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 $^{13} \rm http://cnx.org/content/m37334/latest/figure8.5.PNG/image$

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- * Skewness [Note. Skewness refers to the extent to which the data are normally distributed around the mean. Skewed data involve having either mostly high scores with a few low ones or having mostly low scores with a few high ones.] Readers are referred to the following sources for a more detailed definition of skewness: http://www.statistics.com/index.php?page=glossary&term_id=356 and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb
- To standardize the skewness value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the skewness value from the SPSS output and divide it by the Std. error of skewness. If the resulting calculation is within -3 to +3, then the skewness of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.
- * Kurtosis [Note. Kurtosis also refers to the extent to which the data are normally distributed around the mean. This time, the data are piled up higher than normal around the mean or piled up higher than normal at the ends of the distribution.] Readers are referred to the following sources for a more detailed definition of kurtosis: http://www.statistics.com/index.php?page=glossary& term_id=326 and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb
- To standardize the kurtosis value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the kurtosis value from the SPSS output and divide it by the Std. error of kurtosis. If the resulting calculation is within -3 to +3, then the kurtosis of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.
- * Continue
- * OK

 $^{^{14}} http://cnx.org/content/m37334/latest/figure8.6.PNG/image$

Note: Before you continue to another application you must "UNSPLIT" the files before moving on to other steps:

 \sqrt{Data}

 $\sqrt{\text{Split Files}}$

 \checkmark Analyze all cases, do not create groups

√ OK

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Check for Skewness and Kurtosis values falling within/without the parameters of normality (-3 to +3). Note that each variable below has its own skewness value and its own kurtosis value. Thus, a total of three standardized skewness coefficients and three standardized kurtosis coefficients can be calculated from information in the table below.

 $^{15} \rm http://cnx.org/content/m37334/latest/figure8.7.PNG/image$

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Kurtosis	1.818	42	6.991
Std. Error of Kurtosis	.088	.115	.113

Skewness and Kurtosis Coefficients

Table 9.1

Copy skewness and kurtosis information into the skewness and kurtosis calculator

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9.2.2 Step Two

Compute Descriptive Statistics on the Dependent Variable

- \ast Do so via the ANOVA procedure
- * Note. Do not use the ANOVA statistical significance information provided in the output. Use only the Ms, SDs, and ns.
- * The screen shot will occur in the next step (Mean and standard deviation)

9.2.3 Step Three

 $\begin{array}{l} \mbox{Conduct Analysis of Variance} \\ \sqrt{\ Analyze} \\ \sqrt{\ General \ Linear \ Model} \end{array}$

 $^{^{16} \}rm http://cnx.org/content/m37334/latest/calc.PNG/image$

 $\sqrt{\rm Univariate}$

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 $^{17} http://cnx.org/content/m37334/latest/figure8.8.PNG/image$

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 $^{18} \rm http://cnx.org/content/m37334/latest/figure8.9.PNG/image$

CHAPTER 9. CONDUCTING A PARAMETRIC ONE-WAY ANALYSIS OF VARIANCE

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9.2.4 Step Four

Check for Statistical Significance

- 1. Go to the ANOVA table and look at the far right column labeled Sig to check for statistical significance.
- 2. If you have any value less than .05 then you have statistical significance. Remember to replace the third zero with a 1, if the sig value is .000 (i.e., if the sig value reads as .000, replace the third 0, so it reads as .001).
- 3. Numerical Sentence = $F(df \text{ between, } df \text{ within})_{sp} =_{sp} F \text{ value}_{,sp} p_{sp} <_{sp}.001.$
- 4. The outcome of the ANOVA, F(2,1179) = 503.22, p = .001, was . . .

Dependent Variable: Verbal IQ (Wechsler Verbal Intelligence 3)

Tests Between-Subjects Effects

Source	Type Sum Squares	III of	Df	Mean Square	F	Sig.	Partial Eta Squared
					continued	on next page	

 $^{20} http://cnx.org/content/m37334/latest/figure8.11.PNG/image$

CHAPTER 9. CONDUCTING A PARAMETRIC ONE-WAY ANALYSIS OF VARIANCE

Corrected	101503.093^{a}	2	50751.547	503.219	.000	.461
Model						
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Error	118906.620	1179	100.854			
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Table 9.2

a. R Squared = .461 (Adjusted R Square = .460)

9.2.5 Step Five

1. Partial Eta² is the effect size n^2

- 2. Cohen (1988)
- .01 .059 = small effect size

.06 - .139 = moderate effect size

.14 and above = large effect size

Note. n^2 cannot be greater than 1.00. Therefore, a 0 should not be placed in front of the decimal point.

9.2.6 Step Six:

Narrative and Interpretation

- 1. F value
- 2. degrees of freedom for groups and for participants
- 3. p value
- 4. Post hoc results
- 5. M, SD, and n for each group (in a table)

9.3 Writing Up Your Statistics

So, how do you "write up" your Research Questions and your Results? Schuler W. Huck (2000) in his seminal book entitled, *Reading Statistics and Research*, points to the importance of your audience understanding and making sense of your research in written form. Huck further states:

9.3.1

This book is designed to help people *decipher* what researchers are trying to communicate in the written or oral summaries of their investigations. Here, the goal is simply to distill meaning from the words, symbols, tables, and figures included in the research report. To be competent in this arena, one must not only be able to decipher what's presented but also to "fill in the holes"; this is the case because researchers typically assume that those receiving the research report are familiar with unmentioned details of the research process and statistical treatment of data.

Researchers and Professors John Slate and Ana Rojas-LeBouef understand this critical issue, so often neglected or not addressed by other authors and researchers. They point to the importance of doctoral students "writing up their statistics" in a way that others can understand your reporting and as importantly, interpret the meaning of your significant findings and implications for the preparation and practice of educational leadership. Slate and LeBouef provide you with a model for "writing up your parametric ANOVA statistics."

Click here to view: Writing Up Your Parametric One Way ANOVA Statistics ²¹

9.4 References

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 $^{^{21}}$ http://cnx.org/content/col11299/latest/

 $^{^{22} \}rm http://davidmlane.com/hyperstat/$

²³http://www.statistics.com/index.php?page=glossary&term id=326

 $^{^{24}}$ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20 statisticsb

 $^{^{25} \}rm http://www.statistics.com/index.php?page=glossary\&term_id=356$

 $^{^{26}}$ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20 statisticsb

 $^{^{27} \}rm http://www.statsoft.com/textbook/$

CHAPTER 9. CONDUCTING A PARAMETRIC ONE-WAY ANALYSIS OF VARIANCE

Chapter 10

Conducting a Nonparametric One-Way Analysis of Variance¹



NOTE: This chapter has been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

10.1

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups 3

Authors Information

John R. Slate is a Professor at Sam Houston State University where he teaches Basic and Advanced Statistics courses, as well as professional writing, to doctoral students in Educational Leadership and Counseling. His research interests lie in the use of educational databases, both state and national, to reform school practices. To date, he has chaired and/or served over 100 doctoral student dissertation committees. Recently, Dr. Slate created a website Writing and Statistical Help⁴ to assist students and faculty with both statistical assistance and in editing/writing their dissertations/theses and manuscripts.

¹This content is available online at <<u>http://cnx.org/content/m37335/1.6/></u>.

²http://my.qoop.com/store/NCPEA-Publications-1781472103076212/

 $^{^{3}} http://my.qoop.com/store/NCPEA-Publications-1781472103076212/$

⁴http://www.writingandstatisticalhelp.com

Ana Rojas-LeBouef is a Literacy Specialist at the Reading Center at Sam Houston State University where she teaches developmental reading courses. She recently completed her doctoral degree in Reading, where she conducted a 16-year analysis of Texas statewide data regarding the achievement gap. Her research interests lie in examining the inequities in achievement among ethnic groups. Dr. Rojas-LeBouef also assists students and faculty in their writing and statistical needs on the website Writing and Statistical Help.⁵

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- **Theodore B. Creighton**, is a Professor at Virginia Tech and the Publications Director for NCPEA Publications⁶, the Founding Editor of Education Leadership Review,⁷ and the Senior Editor of the NCPEA Connexions Project.
- **Brad E. Bizzell**, is a recent graduate of the Virginia Tech Doctoral Program in Educational Leadership and Policy Studies, and is a School Improvement Coordinator for the Virginia Tech Training and Technical Assistance Center. In addition, Dr. Bizzell serves as an Assistant Editor of the NCPEA Connexions Project in charge of technical formatting and design.
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- **Thomas Kersten** is a Professor at Roosevelt University in Chicago. Dr. Kersten is widely published and an experienced editor and is the author of Taking the Mystery Out of Illinois School Finance⁸, a Connexions Print on Demand publication. He is also serving as Editor in Residence for this book by Slate and LeBouef.

10.2 Nonparametric One-Way Analysis of Variance

In this set of steps, readers will calculate either a parametric or a nonparametric statistical analysis, depending on whether the data for the dependent variable reflect a normal distribution. A parametric statistical procedure requires that its data be reflective of a normal curve whereas no such assumption is made in the use of a nonparametric procedure. Of the two types of statistical analyses, the parametric procedure is the more powerful one in ascertaining whether or not a statistically significant difference, in this case, exists. As such, parametric procedures are preferred over nonparametric procedures. When data are not normally distributed, however, parametric analyses may provide misleading and inaccurate results. According, nonparametric analyses should be used in cases where data are not reflective of a normal curve. In this set of steps, readers are provided with information on how to make the determination of normally or nonnormally distributed data. For detailed information regarding the assumptions underlying parametric and nonparametric procedures, readers are referred to the Hyperstats Online Statistics Textbook at http://davidmlane.com/hyperstat/ or to the Electronic Statistics Textbook (2011) at http://www.statsoft.com/textbook/

For this nonparametric analysis of variance procedure to be appropriately used, at least half of the standardized skewness coefficients and the standardized kurtosis coefficients must be outside the normal range (+/-3, Onwuegbuzie & Daniel, 2002). Research questions for which nonparametric analysis of variance procedures are appropriate involve asking for differences in a dependent variable by group membership (i.e., more than two groups may be present). The research question, "What is the difference in science performance among middle school students as a function of ethnic membership?" could be answered through use of a nonparametric analysis of variance procedure.

 $^{^{5} \}rm http://www.writing and statistical help.com$

 $^{^{6} \}rm http://www.ncpeapublications.org$

⁷http://ncpeapublications.org/about-elr.html

⁸http://cnx.org/content/col10606/latest/

10.2.1 Step One:

 $\sqrt{\rm Split}$ your file on the basis on your independent variable/fixed factor/grouping variable

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¹⁰http://cnx.org/content/m37335/latest/figure9.2.PNG/image

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¹¹http://cnx.org/content/m37335/latest/figure9.3.PNG/image

CHAPTER 10. CONDUCTING A NONPARAMETRIC ONE-WAY ANALYSIS OF VARIANCE

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* Skewness [Note. Skewness refers to the extent to which the data are normally distributed around the mean. Skewed data involve having either mostly high scores with a few low ones or having mostly low scores with a few high ones.] Readers are referred to the following sources for a more detailed definition of skewness: http://www.statistics.com/index.php?page=glossary&term_id=356 and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb

14

- To standardize the skewness value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the skewness value from the SPSS output and divide it by the Std. error of skewness. If the resulting calculation is within -3 to +3, then the skewness of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.
- * Kurtosis [Note. Kurtosis also refers to the extent to which the data are normally distributed around the mean. This time, the data are piled up higher than normal around the mean or piled up higher than normal at the ends of the distribution.] Readers are referred to the following sources for a more detailed definition of kurtosis: http://www.statistics.com/index.php?page=glossary&term_id=326 and http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb
- To standardize the kurtosis value so that its value can be constant across datasets and across studies, the following calculation must be made: Take the kurtosis value from the SPSS output and divide it by the Std. error of kurtosis. If the resulting calculation is within -3 to +3, then the kurtosis of the dataset is within the range of normality (Onwuegbuzie & Daniel, 2002). If the resulting calculation is outside of this +/-3 range, the dataset is not normally distributed.
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 $^{^{14}} http://cnx.org/content/m37335/latest/figure9.6.PNG/image$
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Check for Skewness and Kurtosis values falling within/without the parameters of normality (-3 to +3). Note that each variable below has its own skewness value and its own kurtosis value. Thus, a total of three standardized skewness coefficients and three standardized kurtosis coefficients can be calculated from information in the table below.

 $^{^{15} \}rm http://cnx.org/content/m37335/latest/figure9.7.PNG/image$

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Std. Error of Skewness)	.044	.058	.056
Kurtosis	1.818	412	6.991
Std. Error of Kurtosis	.008	.115	.113

Skewness and Kurtosis Coefficients

Table 10.1

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10.2.2 Step Two:

Compute Descriptive Statistics on the Dependent Variable

- * Do so via the ANOVA procedure.
- * Note. Do not use the ANOVA statistical significance information provided in the output. Use only the Ms, SDs, and ns.
- * The screen shot will occur in the next step (Mean and standard deviation)

10.2.3 Step Three:

Run Nonparametric One-Way ANOVA on Data

- * Analyze
- * Nonparametric Tests

 $^{^{16} \}rm http://cnx.org/content/m37335/latest/calc.PNG/image$

* k Independent Samples

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* Keep the default of Kruskal-Wallis H checked

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* Test Variable would be your Dependent Variable (e.g., test scores)
* Grouping Variable would be your Independent Variable (categories)
* Define Groups

* Insert the number for your lowest numbered group and then the number for your highest numbered group.

¹⁸http://cnx.org/content/m37335/latest/figure9.10PNG/image

CHAPTER 10. CONDUCTING A NONPARAMETRIC ONE-WAY ANALYSIS OF VARIANCE

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** To obtain the Means and Standard Deviation:

- * Click on options
- * Highlight Descriptive
- * Click Continue

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10.2.4 Step Four:

Check for Statistical Significance Numerical sentence is written as: $X^2 = 430.66$, p < .001

Test Statistics^{a,b}

	Performance IQ (Wechsler Performance Intelligence 3)
Chi-Square	430.661
df	1
Asymp. Sig.	.000

Table 10.2

a. Kruskal Wallis Test

b. Grouping Variable: Disability Group Membership

10.2.5 Step Five:

If you have a statistically significant finding in your nonparametric ANOVA, you need to run the appropriate nonparametric post hocs. Refer to your steps on running the nonparametric independent samples *t*-test.

 $^{^{20}} http://cnx.org/content/m37335/latest/figure9.11.PNG/image$

10.2.6 Step Six:

Calculate Nonparametric Independent Samples t-test on Data

- $\sqrt{\text{Analyze}}$
- $\sqrt{$ Nonparametric Tests
- $\sqrt{2}$ Independent Samples
- $\sqrt{\text{Test Variable would be your Dependent Variable (e.g., test scores)}}$
- $\sqrt{\rm Grouping}$ Variable would be your dichotomous Independent Variable
- $\sqrt{}$ Define Groups
- $\sqrt{\text{Group One is No. 1}}$ and Group Two is No. 2 (or whatever numbers you used to identify each group)

Note: Click on view then value lables to find the code for each group

- $\sqrt{\text{Continue}}$
- √ OK
- Note. The above procedure is repeated for each pairwise comparison. Thus, if you have three groups, you would have three calculations. Correct for inflated error by using the Bonferroni method of adjustment. Take the number of pairwise comparisons you are calculating and divide .05 by that.

Check for Statistical Significance

- 1. Go to the Test Statistics Box and look at the cell in the bottom right column to check for statistical significance.
- If you have any value less than .05 then you have statistical significance. Remember to replace the third zero with a 1, if the value is .000 (i.e., for a sig value of .000, thus it would read .001).

Test Statistics^a

	Performance IQ (Wechsler Performance Intelligence 3)
Mann-Whitney U	6765.500
Wilcoxon W	44166.500
Z	-20.752
Asymp. Sig. (2-tailed)	.000

Table 10.3

a. Grouping Variable: Disability Group Membership

To determine how to report the results of these nonparametric followup procedures, see the chapter on nonparametric independent samples t-test in this book.

10.3 Writing Up Your Nonparamteric ANOVA

So, how do you "write up" your Research Questions and your Results? Schuler W. Huck (2000) in his seminal book entitled, *Reading Statistics and Research*, points to the importance of your audience understanding and making sense of your research in written form. Huck further states:

10.3.1

This book is designed to help people *decipher* what researchers are trying to communicate in the written or oral summaries of their investigations. Here, the goal is simply to distill meaning from the words, symbols, tables, and figures included in the research report. To be competent in this arena, one must not only be

146

able to decipher what's presented but also to "fill in the holes"; this is the case because researchers typically assume that those receiving the research report are familiar with unmentioned details of the research process and statistical treatment of data.

A Note from the Editors

Researchers and Professors John Slate and Ana Rojas-LeBouef understand this critical issue, so often neglected or not addressed by other authors and researchers. They point to the importance of doctoral students "writing up their statistics" in a way that others can understand your reporting and as importantly, interpret the meaning of your significant findings and implications for the preparation and practice of educational leadership. Slate and LeBouef provide you with a model for "writing up your Nonparametric ANOVA statistics."

Click here to view: Writing Up Your Nonparametric ANOVA Statistics²¹

10.4 References

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Lawrence Erbaum

Hyperstats Online Statistics Textbook. (n.d.) Retrieved from http://davidmlane.com/hyperstat/²²

Kurtosis. (n.d.). Definition. Retrieved from http://www.statistics.com/index.php?page=glossary&term_id=326²³ Kurtosis. (n.d.). Definition of normality. Retrieved from http://www.statsoft.com/textbook/basicstatistics/#Descriptive%20statisticsb²⁴

Onwuegbuzie, A. J., & Daniel, L. G. (2002). Uses and misuses of the correlation coefficient. Research in the Schools, 9(1), 73-90.

Skewness. (n.d.) Retrieved from http://www.statistics.com/index.php?page=glossary&term_id=356²⁵

StatSoft, Inc. (2011). Electronic statistics textbook. Tulsa, OK: StatSoft. WEB: http://www.statsoft.com/textbook/²⁷

 $^{^{21} \}rm http://cnx.org/content/col11299/latest/$

 $^{^{22}}$ http://davidmlane.com/hyperstat/

 $^{^{23}} http://www.statistics.com/index.php?page=glossary\&term_id{=}326$

 $^{^{24}}$ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20 statisticsb

 $^{^{25} \}rm http://www.statistics.com/index.php?page=glossary\&term_id=356$

 $^{^{26}}$ http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20 statisticsb

²⁷ http://www.statsoft.com/textbook/

CHAPTER 10. CONDUCTING A NONPARAMETRIC ONE-WAY ANALYSIS OF VARIANCE

Chapter 11

Standardized Skewness and Standardized Kurtosis Coefficient Calculator¹

11.1 Skewness and Kurtosis Calculator

The Standardized Skewness and Kurtosis Coefficient Calculator is to be used with the Book, Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts authored by Professors John R. Slate and Ana Rojas-LeBouef.

Do not try to OPEN the file from here. DOWNLOAD the Excel file to your desktop, where you can use the Calculator to create your Skewness and Kurtosis coefficients.

Click here to download the Skewness and Kurtosis Excel file to your desktop.²

 $^{^{-1}}$ This content is available online at <http://cnx.org/content/m37347/1.3/>.

²See the file at

CHAPTER 11. STANDARDIZED SKEWNESS AND STANDARDIZED KURTOSIS COEFFICIENT CALCULATOR

Chapter 12

Resources: Calculating Basic Statisictics in SPSS¹

This chapter is part of a larger Collection (Book) and is available at: Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts 2

NOTE: Slate and LeBouef have written a "companion book" which is available at: Preparing and Presenting Your Statistical Findings: Model Write Ups ³



NOTE: These Recommended Resources have been peer-reviewed, accepted, and endorsed by the National Council of Professors of Educational Administration (NCPEA) as a significant contribution to the scholarship and practice of education administration. Formatted and edited in Connexions by Theodore Creighton and Brad Bizzell, Virginia Tech, Janet Tareilo, Stephen F. Austin State University, and Thomas Kersten, Roosevelt University.

12.1 Recommended Resources

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Lawrence Erbaum

Hyperstats Online Statistics Textbook. (n.d.) Retrieved from http://davidmlane.com/hyperstat/4

Kurtosis. (n.d.). Definition. Retrieved from http://www.statistics.com/index.php?page=glossary&term_id=326⁵

Onwuegbuzie, A. J., & Daniel, L. G. (2002). Uses and misuses of the correlation coefficient. Research in the Schools, 9(1), 73-90.

 $^{^1{\}rm This}\ {\rm content}\ {\rm is\ available\ online\ at\ <http://cnx.org/content/m37336/1.3/>.$

 $^{^{2}} http://my.qoop.com/store/NCPEA-Publications-1781472103076212/$

 $^{^{3}} http://my.qoop.com/store/NCPEA-Publications-1781472103076212/$

 $^{^{4}} http://davidmlane.com/hyperstat/$

 $^{{}^{5}}http://www.statistics.com/index.php?page=glossary&term_id=326$

 $^{^{6}} http://www.statsoft.com/textbook/basic-statistics/\#Descriptive\%20 statisticsbasic-stati$

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- Skewness. (n.d.). Definition of normality. Retrieved from http://www.statsoft.com/textbook/basic- ${\rm statistics}/\#{\rm Descriptive}\%20 {\rm statistics}{\rm b}^8$
- (2011).Electronic statistics textbook. Tulsa, OK: StatSoft. StatSoft, Inc. WEB: http://www.statsoft.com/textbook/⁹

 $^{^{7}} http://www.statistics.com/index.php?page=glossary\&term_id{=}356$

 $^{^{8}\,\}rm http://www.statsoft.com/textbook/basic-statistics/#Descriptive%20statisticsb<math display="inline">^{9}\,\rm http://www.statsoft.com/textbook/$

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Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts

Calculating Basic Statistical Procedures in SPSS: A Self-Help and Practical Guide to Preparing Theses, Dissertations, and Manuscripts, is authored by John R. Slate and Ana Rojas-LeBouef from Sam Houston State University. This book is written to assist graduate students and faculty members, as well as undergraduate students, in their use of the Statistical Package of the Social Sciences-PC (SPSS-PC) versions 15-19. Specifically, we have generated a set of steps and screenshots to depict each important step in conducting basic statistical analyses. We believe that this book supplements existing statistical texts in which readers are informed about the statistical underpinnings of basic statistical procedures and in which definitions of terms are provided. Accordingly, other than providing a few basic definitions, we assume that dissertation chairs/thesis directors, students, and/or faculty will obtain their own definition of terms. We hope you find this set of steps and screenshots to be helpful as you use SPSS-PC in conducting basic statistical analyses.

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